Leica PaveSmart 3D

User Manual

Version 2.0
English

- when it has to be **right**

Leica Geosystems

Introduction

Purchase

Congratulations on your purchase of the Leica PaveSmart 3D Machine Control System. Leica PaveSmart 3D is an ideal tool for increasing productivity in paving and milling applications.

This manual contains important safety directions as well as instructions for setting up the system and operating it. Refer to "6 Safety Directions" for further information.
Read carefully through the User Manual before you switch on the product.

To ensure safety when using the system, please also observe the directions and instructions contained in the User Manual and Safety Handbook issued by the:

- Machine manufacturer,
- Controller manufacturer and
- Sensor manufacturer.

Product identification

The type and serial number of your product are indicated on the label on the base of the product.

Enter the model and serial number in your manual and always refer to this information when you need to contact your agency or Leica Geosystems authorised service workshop.

Type: MPC1310 Machine Computer	Serial No.:	_____
Type: MSS1200 Dual-Axis Slope Sensor	Serial No.:	_____
Type: TCPS27S Ruggedised Radio Modem	Serial No.:	_____

Symbols

The symbols used in this manual have the following meanings:

Type	Description
⚠ **Danger**	Indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
⚠ **Warning**	Indicates a potentially hazardous situation or an unintended use which, if not avoided, could result in death or serious injury.
⚠ **Caution**	Indicates a potentially hazardous situation or an unintended use which, if not avoided, may result in minor or moderate injury and/or appreciable material, financial and environmental damage.
☞	Important paragraphs which must be adhered to in practice as they enable the product to be used in a technically correct and efficient manner.

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1 How to use this Manual

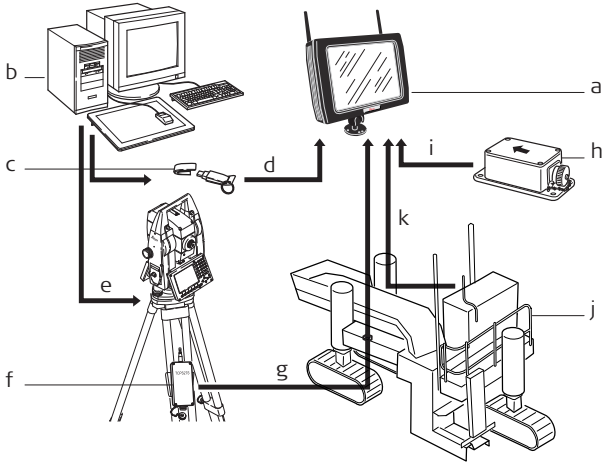
Applicability of this manual

This User Manual is for **Leica PaveSmart 3D**, for use to control paving and milling machines.

Introduction to Leica PaveSmart 3D

Conventionally, paving and milling machines are controlled for elevation and steering by a stringline. These are staked-out by a survey crew; positioning the pins and setting the wires is a demanding and error-prone surveying task. When the stringlines are in place, they cause a significant logistical problem for concrete delivery and further poses a safety risk for operatives. Furthermore, damage caused to the stringline, from personnel or concrete trucks can seriously interfere with production. Undetected problems can result in the costly removal and replacement of expensive material.

With **Leica**'s **PaveSmart 3D** control system, the machine is controlled without stringlines. One or two Leica Geosystems robotic total stations or GNSS (GPS / GLONASS) sensors measure the position of specific points on the machine at a rate of approximately 10 Hz. These measurements are transmitted by radio to the Leica Machine Computer (MPC1310), mounted on the machine. High-accuracy machine-mounted slope sensors provide additional information on the longslope (mainfall) and crossslope (crossfall) of the machine. From this pool of position, height and slope information, **Leica PaveSmart 3D** then continuously calculates the current or **Actual** position, elevation and slopes of the machine, and the heading (or direction of travel) of the machine.
These **Actual** position, elevation and slope values are compared to the computerised 3D **Design** model of the project. The results of this **Design-vs-Actual** comparison, are called **Corrections**. These represent the amount of **Corrections** (in position, elevation and slope) required to bring the machine back **online** and **ongrade**. **Leica PaveSmart 3D** transmits these **Corrections** to the machine controller, which regulates the hydraulics, in a similar way to controlling with the conventional stringline sensors.



a) MPC1310
b) CAD-PC
c) USB storage device
d) Project data
e) Reference point list (OnBoard or hand-held application)
f) TCPS27 or FreeWave Radio modem
g) Measured value Hz, V, Dist
h) Slope sensor
i) Actual longslope & crossslope of the machine
j) Machine
k) Parameters for position and height

Contents of this manual

The **Leica PaveSmart 3D** User Manual is designed into four key sections. System setup Information is now presented in a step-by-step format:

1. Getting Started (Daily Operations, Project Setup, Hints and Tips)
2. System Components (Diagrams & Software Description)
3. Troubleshooting (Detailed Troubleshooting Chart)
4. Care and Transport / Safety Directions

Path

Work: Offset\Steer stands for this working sequence:
From the **Work** dialog select **Offset** and then select **Steer**.
Leica PaveSmart 3D paths always start either in the **Work** dialog or in the **Menu** dialog.

Screen

Work\Elevation Offsets\Steer Offsets describes the name of the screen.

Fields and options

Fields displayed on the screen are described such as **<Speed:>** or **<Speed: ft/min>**, if "ft/min" is the selected speed unit.

Index

The index is at the end of the manual.

Keys, fields and options on the screens which are considered as self-explanatory are not explained.

Available documentation

Name of documentation	Description
Leica PaveSmart 3D User Manual	All instructions required in order to operate the system to a basic level are contained in this User Manual. It provides an overview of the system together with technical data and safety directions.
Leica PaveSmart 3D Technical Reference Manual for : • Curb & Gutter • Milling • Road Paver	Overall comprehensive guide to the system functions. Included are detailed descriptions of special system settings and functions intended for technical specialists.
Leica TPS1200+ User Manual	Contains important safety directions as well as instructions for setting up the TPS1200+ product and operating it.
Leica MNS1200 User Manual	Contains important safety directions as well as instructions for setting up the MNS1200 product and operating it.
Leica TPS1200+ Technical Reference Manual	Contains detailed technical instructions for setting up the TPS1200+ product and operating it.
Leica GPS1200+ Technical Reference Manual	Contains detailed technical instructions for setting up the GPS1200+ product and operating it. The manual can also be used for the PowerBox.

Name of documentation	Description
Leica Mguide User Manual	Contains instructions for setting up the Mguide onboard application for TPS1200+ and operating it.
Leica TCPS27 User Manual	Contains important safety directions as well as technical instructions for setting up the TCPS27 product and operating it. (optional)
FreeWave Radio Manual	Contains important safety directions as well as technical instructions for setting up the FreeWave radio modems and operating them. (optional)
MPC1310 User Manual	Contains important safety directions as well as a general description of technical processes and instructions for using and operating the MPC1310.
Leica GNSS Machine Positioning User Manual	Contains important safety directions as well as instructions for setting up the Leica GNSS products and operating them.
GeoPad User Manual	Contains important safety directions as well as instructions for setting up GeoPad and operating it.
Leica PowerTracker User Manual	Contains important safety directions as well as instructions for setting up the Leica PowerTracker product and operating it.

All documents must be read before commencing working on the machine.

Format of the documentation

The Leica PaveSmart 3D CD contains the entire system documentation in electronic format. The user manuals are also available in printed form.

2 Getting Started

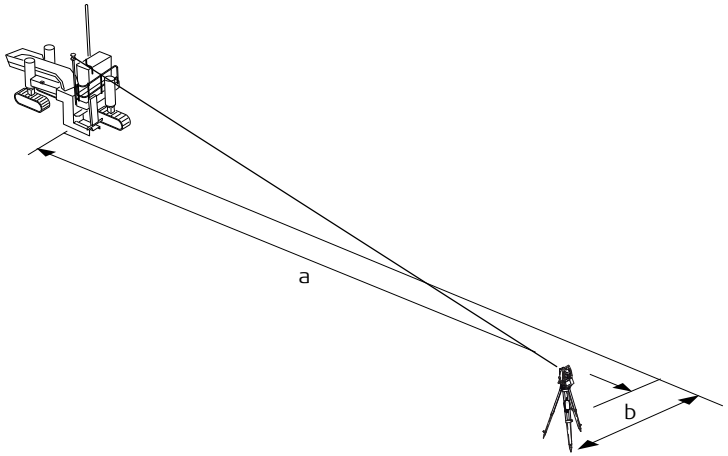
2.1 Preparing the Leica PaveSmart 3D System

Further reading

Refer to the Leica PaveSmart 3D Technical Reference Manuals, the GeoPad User Manual or to the MGuide1200 Application Program Manual on how to perform a Resection (Free Station), Known Point setup and how to take As-Built measurements.

Before production

Connect the MPC Computer: Attach the MPC1310 computer to the machine. Connect power, radio- and CAN cables if available.
Set up all required sensors: TPS and GNSS (GPS / GLONASS) reference station with the required accessories as battery, radio and cables. Ensure all TPS are running either in MGuide with the appropriate configuration set, or correctly configured when working with a hand-held application GeoPad.



a) Max. 200m (600 ft)
b) Min. 10m (30 ft)

Set up Fixpoint Prisms over suitable fixpoints, ready for Free Station or Known Point Setups.

Once all TPS and prisms are set up, go to each of them, **Level** and perform a **Resection** (**Free Station**) or **Known Point Setup** (refer to the MGuide1200 Application Program Manual or the GeoPad User Manual, depending on your type of instrument / work flow).

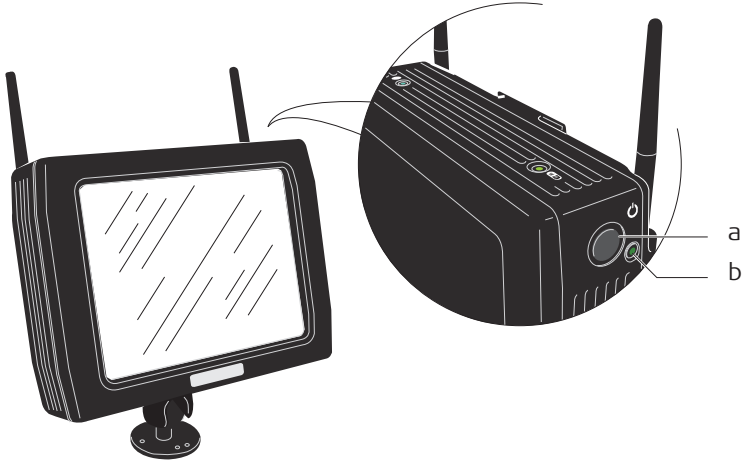
If working with GNSS (GPS / GLONASS) start the reference station to obtain correction data for the GNSS machine sensor (refer to the Leica MNS1200 or the Leica GNSS Machine Positioning User Manual).

At the Leica PaveSmart 3D computer: In the dialog **Work\Sensor\Arrange** select which sensor will be used as **<Primary>** and optionally as **<Secondary>** and **<Spare>**.

Switch on machine and allow **hydraulic system to warm** to a suitable operating temperature before starting work.

2.2 Operating the MPC1310 Machine Computer

Starting the MPC1310



a) Power key
b) Power indicator

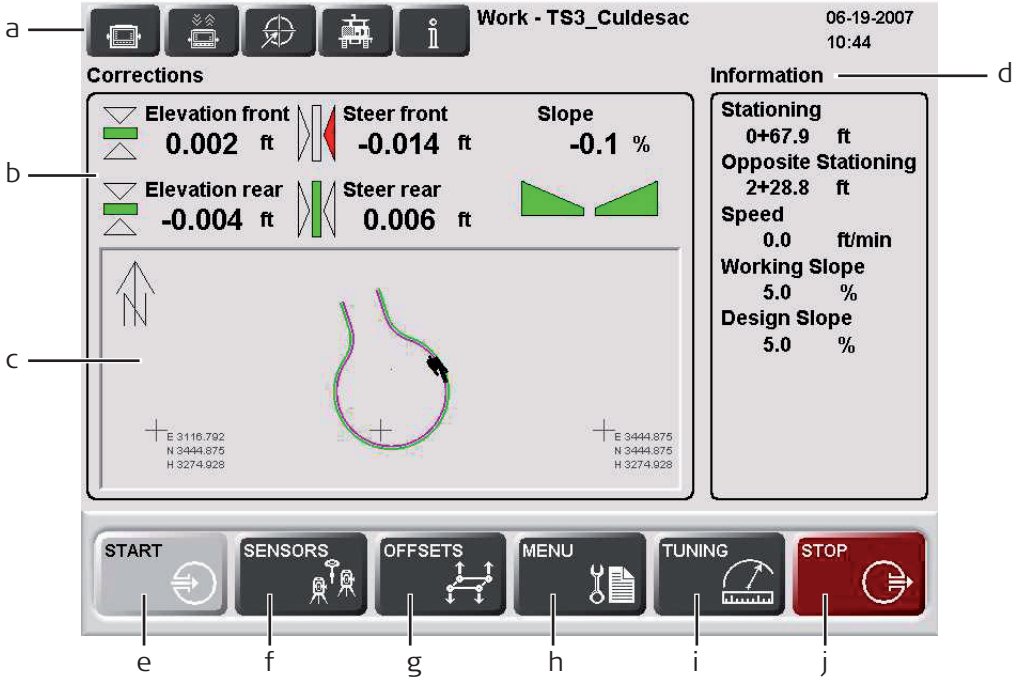
The power key is located on the upper right side of the MPC1310.
When power is supplied for the MPC1310, press the power key to start the MPC1310. After pressing the key, the power indicator LED will show green, and the MPC1310 will start booting-up.

Ensure that there is sufficient power supply. If not, switch on the machine's ignition or start the engine.

Work Dialog

Depending on the machine type, a different machine profile is loaded (Milling-, Concrete Curb&Gutter- or Road (Asphalt) Paver Profile).
The Work dialog screen shows all the information needed while the machine is in operation.

Work Dialog Curb and Gutter:



a) **Dashboard / Error messages**: the specific icon flashes yellow if a warning is detected or flashes red if an error occurres. By pressing on the specific button additional information and troubleshooting tips will be displayed.
   1.) MPC1310 messages
   2.) Communication messages
   3.) Sensor messages
   4.) Machine messages
   5.) Software messages

b) **Corrections**: indicates the required corrections for the elevation of the mold (front and rear) and the position of the mold (front and rear). For example, if the front height correction shows -0.013 (in m or ft), the machine has to lower the front of the mold by 0.013 (in m or ft).

c) **Design display**: shows the whole project and the current machine position.

d) **Information**: provides information about the work progress.
   - **Stationing** shows current Stationing or Chainage (in m or ft).
   - **Opposite Stationing** shows the inverted Stationing or Chainage, the difference to the end (in m or ft).
   - **Speed** indicates current Speed of the machine (in m/min or ft/min).
   - **Working Slope** shows the current Working Slope, which is the Design Slope at the current position plus the Slope Offset.
   - **Desing Slope** is the Design Cross Slope at the current position. It's calculated out of the ReferenceLine and the SlopeLine.

e)

Press and hold for more than 1 second to start active Control.

f)

opens the Sensor dialog to manage the TPS and GNSS (GPS / GLONASS) sensors.

g)

opens the Offset dialog to set the working mold offsets relative to the stringline.

h)

opens the Menu dialog to configure the Leica PaveSmart 3D software.

i)

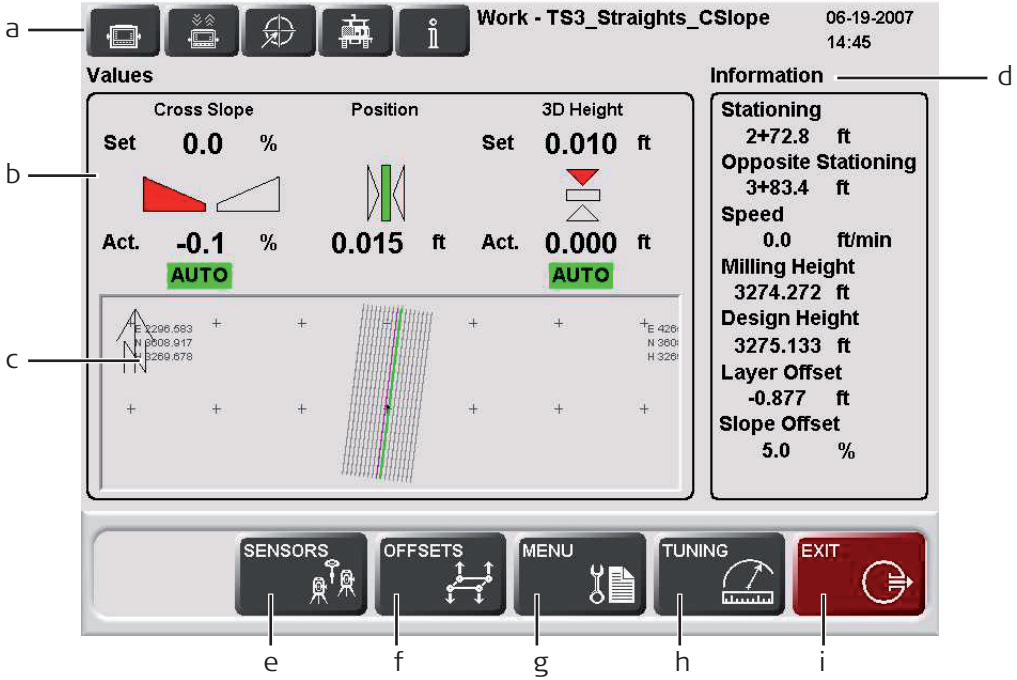
opens the Tuning dialog to set the hydraulics parameters for the machine.

j)

press and hold for more than 1 second to stop active Control and in a second step to close the software and shut down the MPC1310.

☞ **Do not power off the MPC1310 by holding down the Power Key!** Always shut down the MPC1310 by using the Exit button to ensure all important project data are saved.

Work Dialog Milling:



a) **Dashboard / Error messages**: the specific icon flashes yellow if a warning is detected or flashes red if an error occurres. By pressing on the specific button additional information and troubleshooting tips will be displayed.
   1.) MPC1310 messages
   2.) Communication messages

3.) Sensor messages
4.) Machine messages
5.) Software messages

b) **Corrections**: indicates the required corrections for the elevation and cross slope of the milling head and the position of the milling head. For example, if the height correction shows 0.010 (in m or ft), the machine has to lower the milling head by 0.010 (in m or ft). The values and settings are exactly the same as those displayed on the machine controller and can be changed manually on the controller or automatically through PaveSmart 3D.

c) **Design display**: shows the whole project and the current machine position.

d) **Information**: provides information about the work progress.
- **Stationing** shows current Stationing or Chainage (in m or ft).
- **Opposite Stationing** shows the inverted Stationing or Chainage, the difference to the end (in m or ft).
- **Speed** indicates current Speed of the machine (in m/min or ft/min).
- **Milling height** is the calculated height of the control point at the mast foot point.
- **Design height** is the project design height at the actual position.
- **Layer Offset** is the height offset, which is added to the design elevation constantly.
- **Slope Offset** is the active offset when working with a slope side.

e)

opens the Sensor dialog to manage the TPS and GNSS (GPS / GLONASS) sensors.

f)

opens the Offset dialog to set the working mold offsets relative to the stringline.

g)

opens the Menu dialog to configure the Leica PaveSmart 3D software.

h)

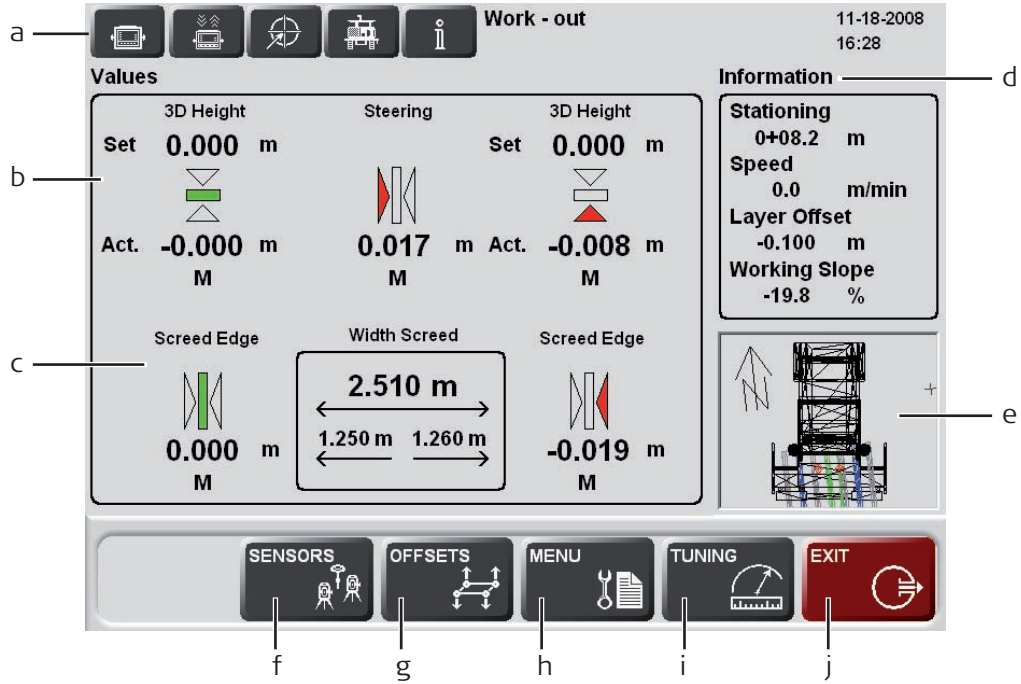
opens the Tuning dialog to set the hydraulics parameters for the machine.

i)

press and hold for more than 1 second to stop active Control and in a second step to close the software and shut down the MPC1310.

Do not power off the MPC1310 by holding down the Power Key! Always shut down the MPC1310 by using the Exit button to ensure all important project data are saved.

Work Dialog Road Paver:



a) **Dashboard / Error messages**: the specific icon flashes yellow if a warning is detected or flashes red if an error occurres. By pressing on the specific button additional information and troubleshooting tips will be displayed.
   1.) MPC1310 messages
   2.) Communication messages
   3.) Sensor messages
   4.) Machine messages
   5.) Software messages

b) **Corrections**: indicates the required corrections for steering / position deviation, elevation and cross slope. For example, if the Set value is 1.0 and the actual value is 1.1 (in m or ft), the machine has to lower the tow arm until the set- and actual values are both the same (1.0). The values and settings are exactly the same as those displayed on the machine controller and can be changed manually on the controller using the height correction buttons (Set Value).

c) **Screed Information**: indicates the corrections for the Screed Edge left and right. Inside the box you see the current total width of the screed and the width for the left part of the screed (1.250 m) and for the right part of the screed (1.260 m).

d) **Information**: provides information about the work progress.
   - **Stationing** shows current Stationing or Chainage (in m or ft).
   - **Speed** indicates current Speed of the machine (in m/min or ft/min).
   - **Layer Offset** shows the actual layer offset of PaveSmart 3D (Elevation Offsets).
   - **Working Slope** shows the current Working Slope, which is the Design Slope at the current position plus the Slope Offset.

e) **Design display**: shows the whole project and the current machine position.

f)

opens the Sensor dialog to manage the TPS and GNSS (GPS / GLONASS) sensors.

g)

opens the Offset dialog to set the working mold offsets relative to the stringline.

h)

opens the Menu dialog to configure the Leica PaveSmart 3D software.

i)

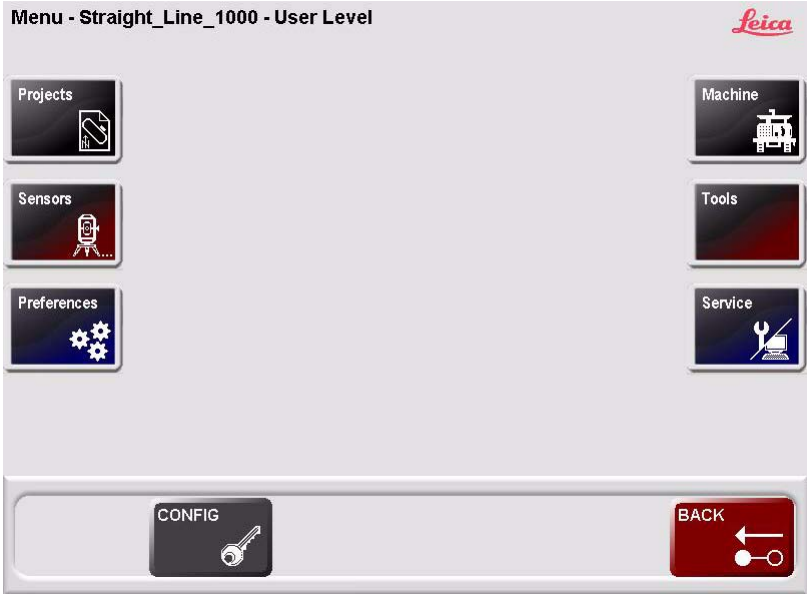
opens the Tuning dialog to set the hydraulics parameters for the machine. The tuning of the hydraulic is usually done at the controller.

j)

press and hold for more than 1 second to stop active Control and in a second step to close the software and shut down the MPC1310.

Do not power off the MPC1310 by holding down the Power Key! Always shut down the MPC1310 by using the Exit button to ensure all important project data are saved.

Menu dialog



In all dialogs, the following buttons are used to navigate, confirm or reject changes to settings.

confirm your changes to system settings and continue.

reject your setting changes and go back to previous dialog.

The Menu dialog offers several opportunities to configure the Leica PaveSmart 3D software. The machine and the current task have an influence on the configuration required.

contains all project and job relevant dialogs to manage jobs, log files, as-built recordings and backups.

To define with which sensor configuration (TPS, TPS/GNSS) is being used and to configure all attached sensors.

General settings such as units etc.

To define the machine dimensions, locks and stops, production tolerances and the machine tuning.

Access to the data flow and the external radio configuration tools.

To enable the protected dialogs (if disabled) and opens dialog to enter the password.

Contains various tools for service personal only. Customer access only under Leica supervision.

Config dialog

Optional protected by a password which can be set in the Settings / General dialog, containing settings which are usually not used in daily production and should only be edited by a trained system administrator (n.b. Default password = 007).

Service dialog

Password protected menu for Leica support personnel only.

Numeric keyboard

By pressing on any editable value in a dialog, the numeric keypad will be opened automatically.

Edit the current, or enter a new value and press OK. The keyboard will close and the new value will be used. If you have made a mistake, simply press again to edit the number.

+/- key toggles the sign of the number between positive and negative.

DEL deletes entered values.

ESC abandons your changes, and reverts to the initial value.

Text keyboard

By pressing in text edit field the text keypad will be open automatically.

Enter or edit text and press OK.
This keyboard operates similarly to the numeric keypad. Refer to "Numeric keyboard", page 23 for more information.

2.3 Rules for Defining Projects

Overview

Leica PaveSmart 3D requires accurate design data to be able to control the machines movements. The machine is only capable of following the information contained within the design data, therefore the quality of the final product is directly influenced by the quality of the data used.

The control process is also influenced by the design data. **The greater the number of segments contained within the design the greater the processing power required to run the system.** A balance must be found between the number of segments required to define the design and the processing power it will require.

The recommendations detailed below must be followed when creating designs.
Without following these rules Leica Geosystems cannot guarantee good quality paving performance.

Angle change between segments

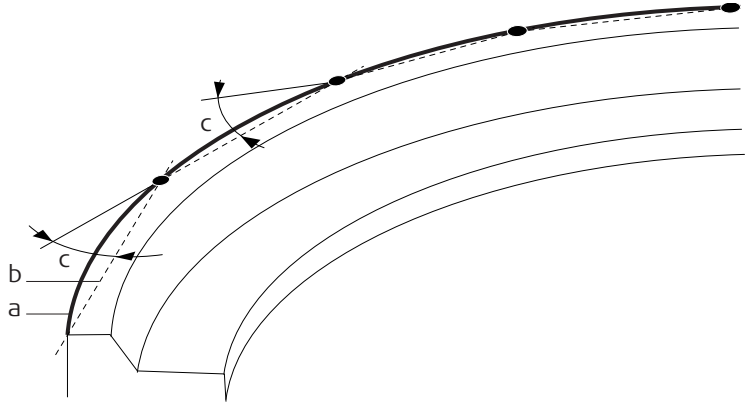
Leica PaveSmart 3D is capable of using designs in a 3 dimensional format which may contain

- Straights
- Arcs
- Clothoids, entry and exit as well as partial
- Cubic parabolas
- Full/Partial Bloss curves (parabola of degree five)

Using these shapes only a small number of segments are required to define any 3 dimensional shapes.

Not all CAD systems are capable of producing curved 3-dimensional polylines. To overcome this curved line segments are broken up into a number of individual straight-line segments. The closer these straight segments are together the more accurate the original design data is approximated.

- When approximating curved 3 dimensional line segments the angle change between two connected line segments must never be greater than 1 degree (1°).
- When defining a straight line it is not necessary to add more points in the middle of a line.



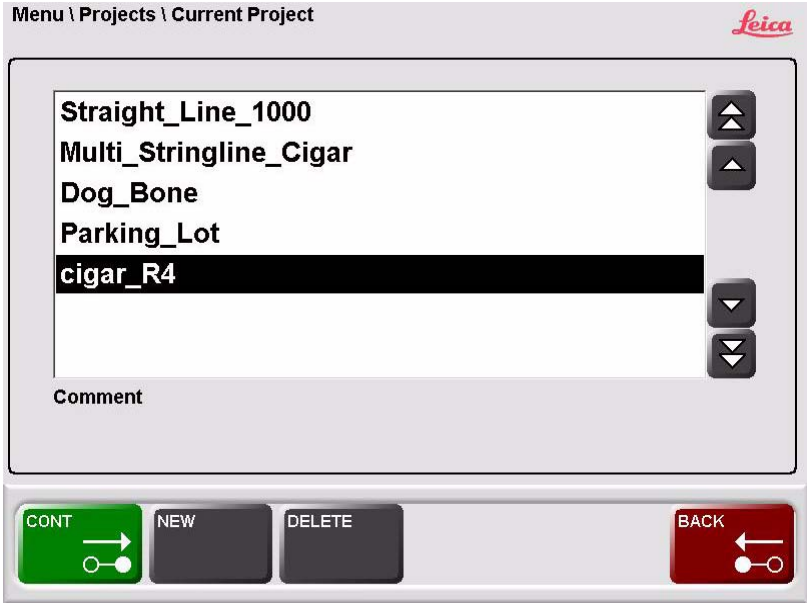
a) Reference line
b) Line segments
c) Angle change ≤ 1°

Number of Segments

The number of segments contained within a single stringline must not exceed **2000 individual elements**. It is possible to have multiple stringlines on the same layer but each individual stringline must not exceed 2000 elements.
If a single stringline requires more than 2000 elements it must be broken into more than one stringline, which must be paved separately.

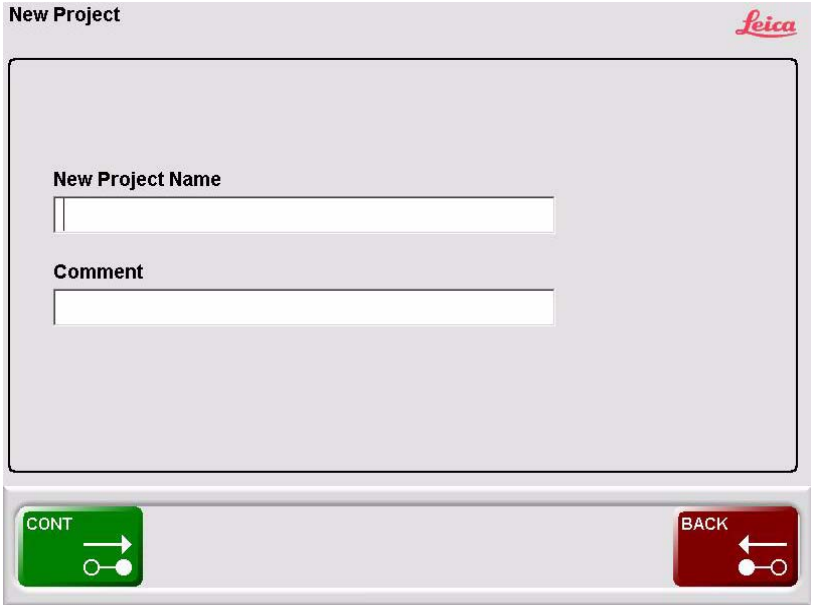
Creating a new project

start from Menu: Projects \ Current

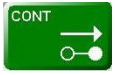


create a new project

Entering Name and Comment



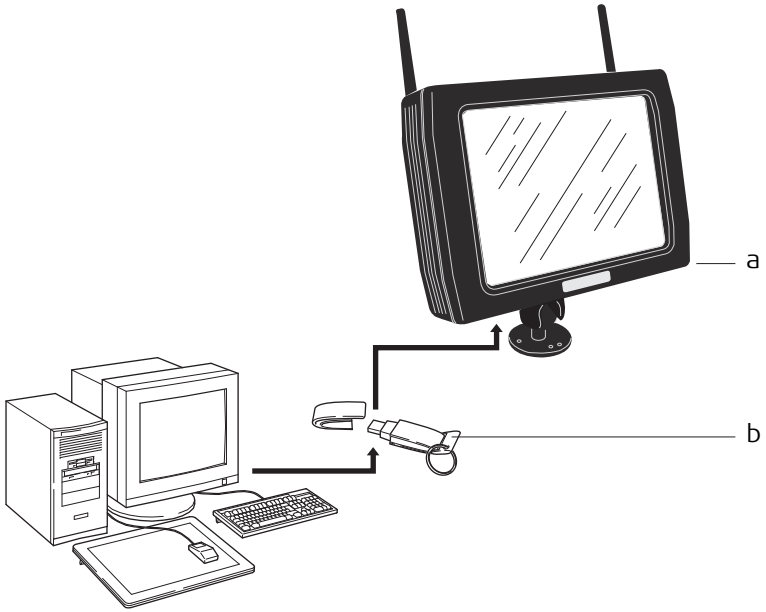
<New Project Name:> enter the name of the new project.
<Comment:> enter a comment to describe the project in detail.



confirm the input and continue

☞ Before creating a new Project name, you must first have the design data available in DBX or LandXML format on the external USB data stick in the \DBX folder. If the \DBX folder does not already exist on the stick, use Windows Explorer to create the folder.

Importing jobs from USB Port

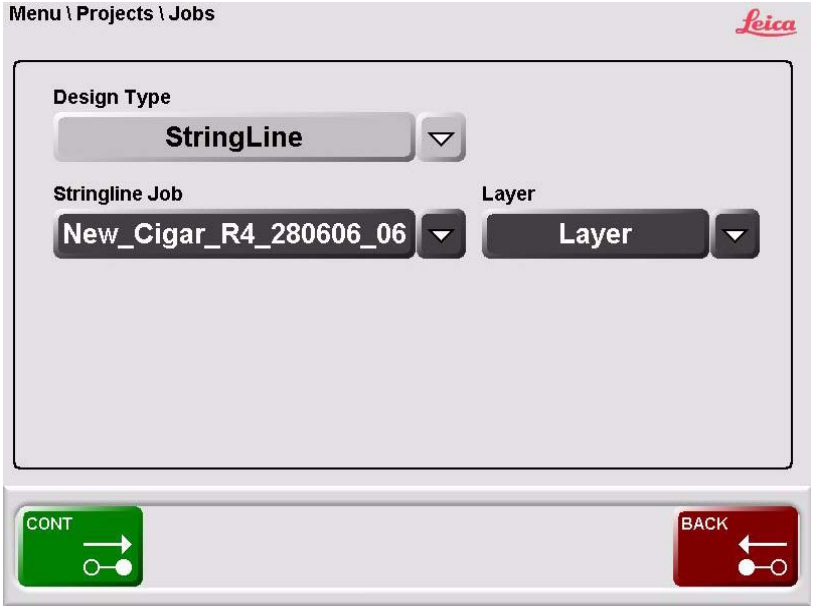


a) MPC1310
b) USB storage device

The USB port (labelled USB A) is located on the bottom of the MPC1310. Connect your USB storage device with the prepared design data on it to the USB port on the MPC1310.

The design data must be stored on the storage device in a folder named \DBX.

Selecting Design Type and Layer

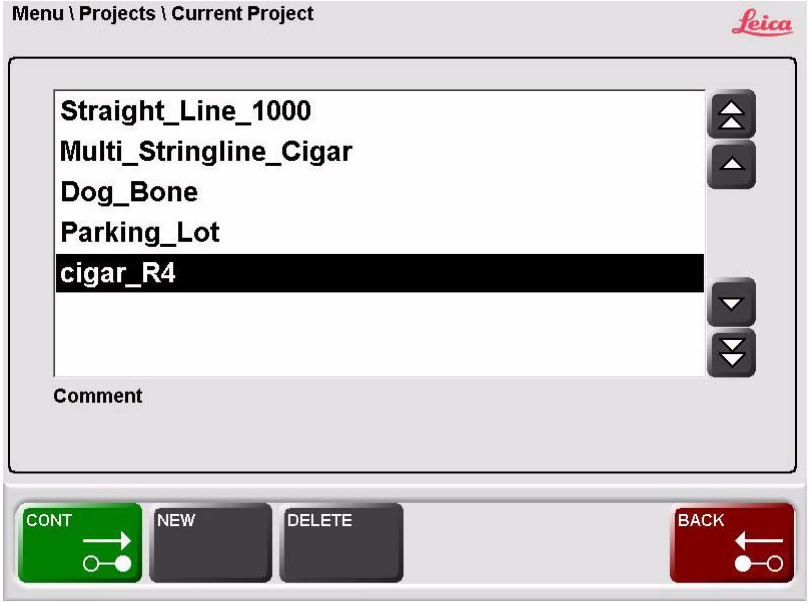


<Design Type> defines the job type you want to work with:

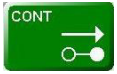
- **<StringLine>** is selected as the default ‹Design Type›.
- **<StringLine Job>** shows the currently selected StringLine job. Only one layer from the stringline job can selected at a time. Select the appropriate layer from the **<Layer>** dialog.

confirm the selections and continue.

Selecting the current Project



The newly created project is automatically highlighted as the current project. If a different project is required it may be selected.



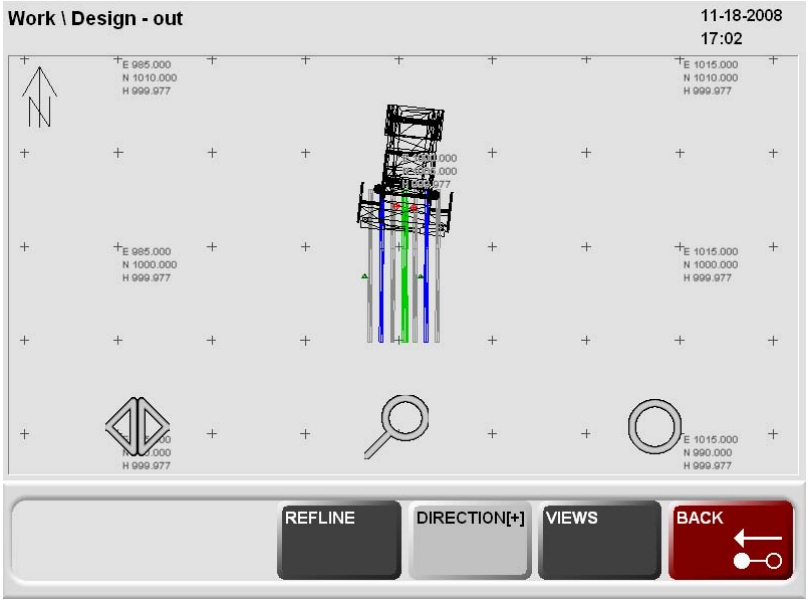
confirm the selection and continue.

New Project created, but not selected. Back to Menu.

2.5 Selecting Design Reference Lines

Design dialog

From the Work dialog doubleclick on the Design window to see the Work \ Design dialog:



set all deviations to zero. **This function is not available for all machine types.**

to chose a reference line, a slope line (or automatically chosen), and screed edge lines (only for NaviTronic controller available).

change the working direction (with or against the stationing). This is only needed for the one TPS or one GNSS (GPS / GLONASS) solution.

leads to the Work \ Design \ Graphics dialog where some more graphical functions such as 3D view are available.

Selecting Reference-Line and SlopeLine

The selection of the Reference Lines is either done automatically or manually.

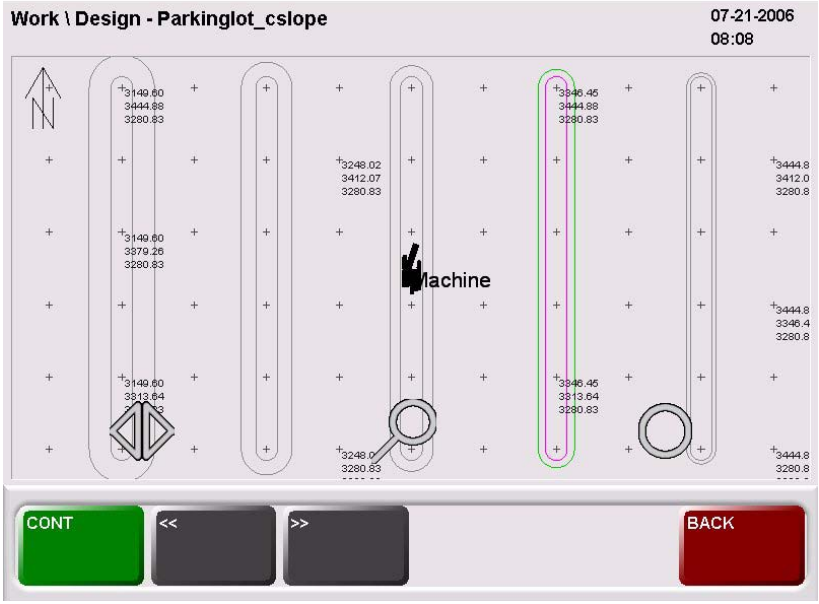
- **Automatically** means the system is determining automatically the next reference line on the left- and the right side of the machine (or its height control point) to calculate the design height- and slope.
- **Manually** you chose the ReferenceLine and optional a SlopeLine. When using the Road Paver profile this can be disabled in Menu \ Preferences \ General ‹ Disable Automatic Line Selection ›. When using the screed extention control with the Vögele NaviTronic controller, the procedure asks for the Edge Line definition after the steering line has been chosen.

Milling: Line Selection is always manually, Automatic Line Selection is not available.

Curb&Cutter: Line Selection is always manually, Automatic Line Selection is not available.

Road Paver: Automatic line selection is by default disabled. By enabling, PaveSmart 3D is determining automatically the relevant ReferenceLines.

After choosing a ReferenceLine, the procedure asks to choose EdgeLines. Choose the EdgeLine for both sides of the screed.

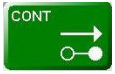


with the arrow buttons you choose ReferenceLine, SlopeLine and EdgeLines , depending on the machine and configuration.

use the graphical pan function to shift the current design window over the project.

use the graphical zoom function to zoom in and out the current design window.

use the graphical rotation function to rotate the whole design.



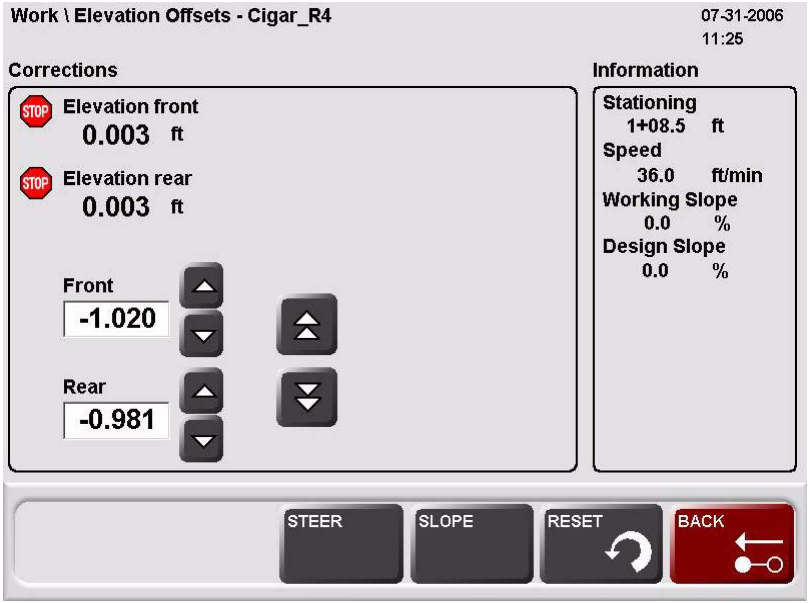
confirm the highlighted ReferenceLine and continue.

Selecting EdgeLines

This feature is only available for the Voegele NaviTronic controller.

Entering offsets

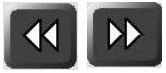
start in **Work \ Offset**.



The offset dialog can look slightly different depending on the loaded profile and the attached sensors, the functionality is the same.

increase or decrease individually the **<Front>** or **<Rear>** Working Offsets step by step.

increase or decrease the **<Front>** and the **<Rear>** Working Offsets together step by step.

 Press the **<Front>** or **<Rear>** edit field to get the numeric keyboard.

Enter a new offset and press OK.

from **Work \ Elevation Offsets \ Steer Offsets**

Enter the **<Front>** or **<Rear>** steering offsets in the same way as the elevation offsets.

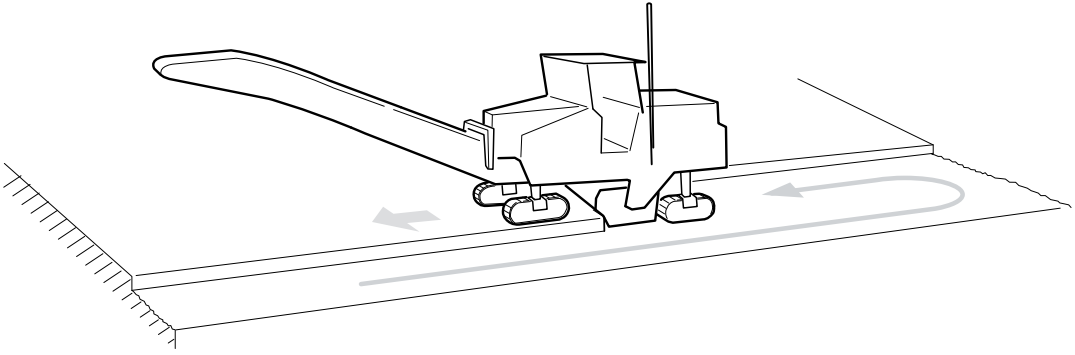
from **Work \ Elevation Offsets \ Slope Offset**

Enter the **<Cross Slope>** offset in the same way as the elevation offsets. The cross slope offset determines catch / spill curb if there is no cross-slope information in the job.

2.6 Continue Working Depending on the Current Machine Position

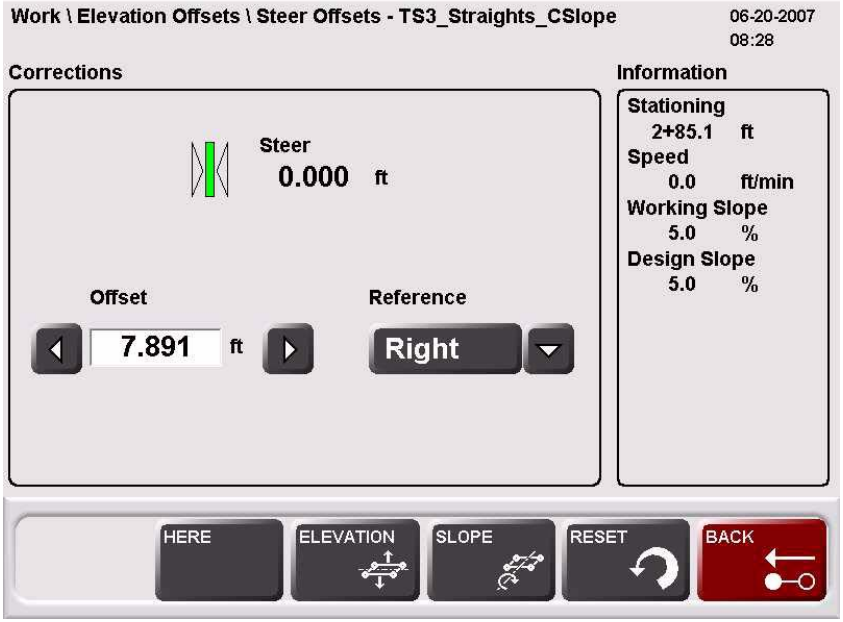
Introduction

The "Here" function is available for the milling application and is used especially in milling tasks when it is required to work in parallel lanes. The lanes depend on the milling head width and not on the design data. The function is used when one lane is finished, and the operator wants to turn the machine around and work along an existing edge. The operator can use the Here function, which brings the steering correction to zero by changing the steering offset. The function is also available for elevation and cross slope or all together.



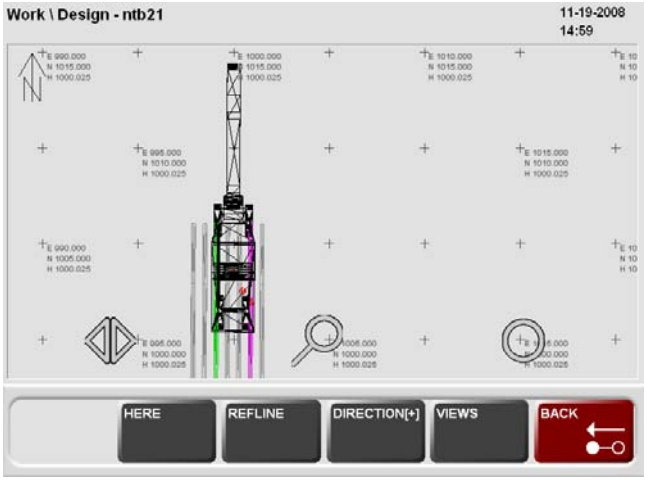
Here Function Steering

From the Work dialog go **Work: Offsets \ Steer** to the following dialog:



The setting **<Reference: Right>** sets the offsets to be measured to the right side of the milling head. Other options are: **<Reference: Center>** and **<Reference: Left>**.

a new offset value is set corresponding to the indicated correction. After pressing the button, the correction is zero. The offset value is the distance between the reference line and the current machine position.



Here Function Road Paver / Steer Offsets

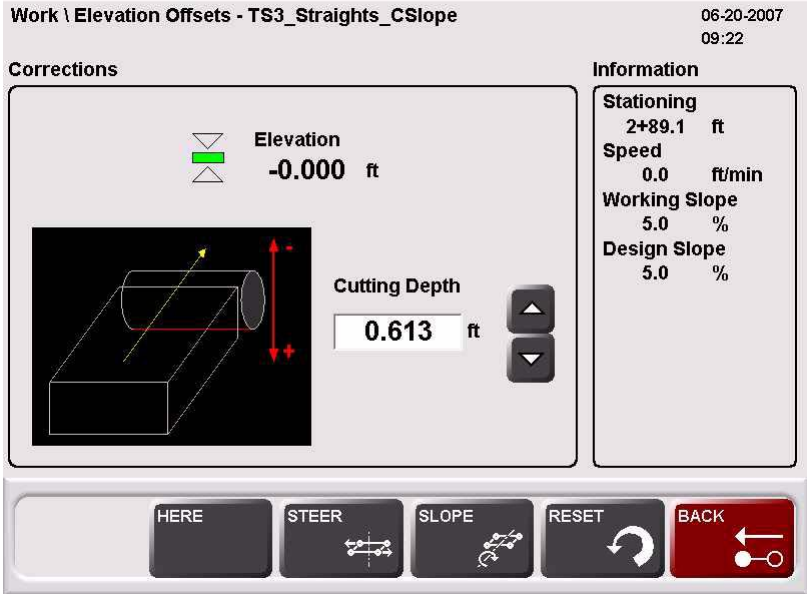
: The Screed Offsets and the steering offset are adjusted individually.

sets an Offset that makes the correction zero.

: All 3 offsets are changed simultaniously / in parallel.

Here Function Elevation

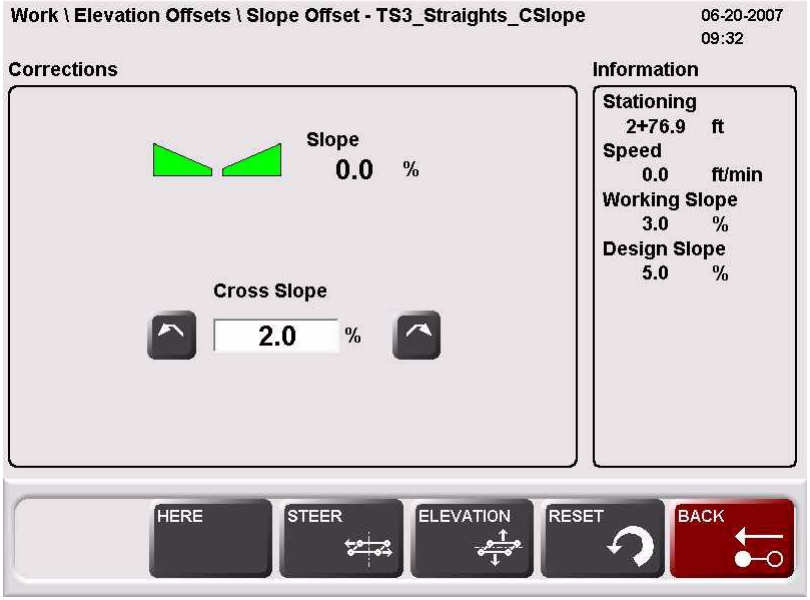
From the Work dialog go **Work: Offsets** to the following dialog:



a new cutting depth is set corresponding to the indicated correction. After pressing the button, the correction is zero. The cutting depth is the difference in elevation between the design surface and the current milling head elevation.

Here Function Slope

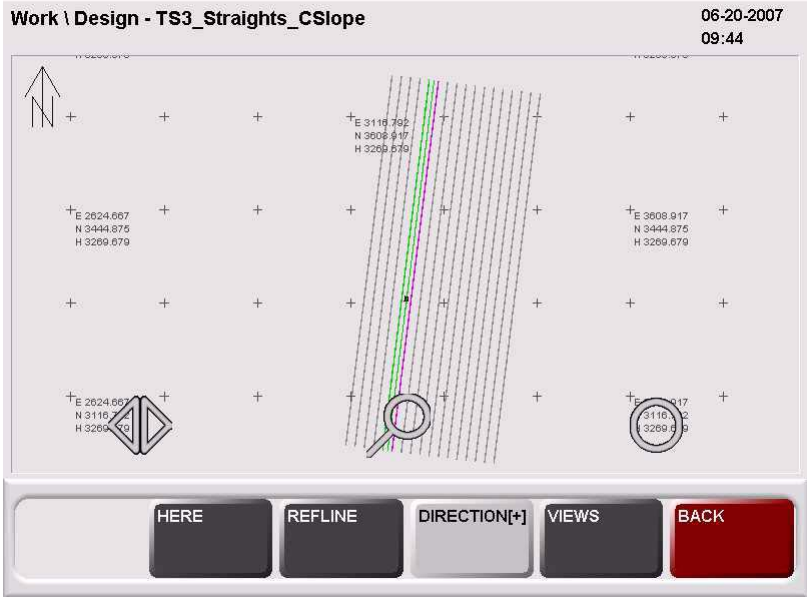
From the Work dialog go **Work: Offsets \ Slope** to the following dialog:



a new cross slope offset is set corresponding to the indicated correction. After pressing the button, the correction is zero. The cross slope offset is the difference between the design slope and the current cross slope of the milling head.

Over all Here Function

From the Work dialog press on the graphic to get to the following dialog:



in the **Work: Design Dialog** all of the above mentioned Here Functions are combined. The Here button in the Graphic dialog sets the steering offset, the cutting depth and the slope offset in that way, that all the corrections are zero.

2.7 Positioning the Machine for Production

Get machine onto line and level	Note the current deviations with as-built checks. Liaise with the machine operator to get machine onto line and level.
Curb and Gutter	Ensure that the machine controller is set to the correct steering mode (e.g. Leica 3D Mode), with Steer & Elev. Sensitivities set to Minimum and all control loops set to Automatic. Start Leica PaveSmart 3D automatic control by pressing the START button for one second.
Milling	Scratch the surface with the drum and dial in the offset you calculated with your as-built checks. Ensure the controller is showing plausible actual values. Depending on application and material, go to your milling depth by start manually or directly in Automatic. Check milling depth immediately with some As-Built Measurements.
Road Paver	Ensure the underlying material to set the screed onto is on the correct height and the tow arms are in the correct position for the paving depth. Start paving in manual mode and the check surface height (manual corrections). When the desired height is achieved and the screed has found its position, set the corrections (set values) in conjunction with the actual value and go into automatic. **Automatic steering- and screed edge control:** Position the machine within 10 cm accuracy in parallel to the project. Use the HERE function ( ) in the offset dialog to adjust the screed deviations after positioning the screed edge to its desired width.

2.8 Taking As-Built Measurements

Description

To check elevation and position during production, Leica PaveSmart 3D has an integrated as-built (Control) function to replace the manual dipping method used when working on string line. Regular, independent as-built measurements are essential to verify product is in project tolerances.

☞ Measurements are only possible if the instrument is correctly positioned and orientated within the project coordinate system (Free Station or Known Point setup)

Taking As-built control measurements

Refer to the MGUIDE User Manual for the instrument type and for detailed instructions on making as-built measurements. Customers using PowerTracker instruments refer to the PowerTracker User Manual and the Geo-Pad User Manual or Site Foreman User Manual on how to take As-built measurements.

Display and recording As-built control measurements

Immediately after an As-built control measurement has been made the results can be seen in the Work\Design dialog. The results are also recorded in the active project folder in the Asbuilt.abr file. **Work: Menu** \ **Projects** \ **AsBuilt**, and can be exported to provide a permanent quality-assurance record.

☞ Care must be taken when taking as-built measurements very close to a free-standing edge on freshly slipformed concrete - this may give misleading results, due to the uncontrollable **slump** of the material at the unsupported edge.

2.9 Leapfrogging (Swapping TPS)

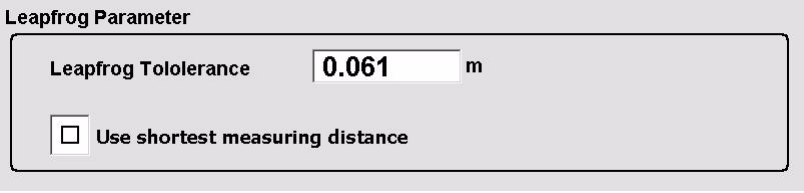
Purpose

Leapfrogging refers to the method of transferring measurement of a machine prism from one total station to another. This is usually required when the machine has reached a predetermined distance from the total station, e.g. 100m (300').

Setting the leapfrog parameters

**Work \ Sensor \ Arrange **

Leapfrog tolerance: The maximum deviation between the currently measured prism coordinates and the newly measured prism coordinates must be set.
Use shortest measuring distance: The details of the TPS to be removed from active control process must be selected. If the use shortest measuring distance option is selected, the TPS measuring the shortest distance to the prism will be removed from active control. If this is not selected the longest measuring instrument will be removed from active control.

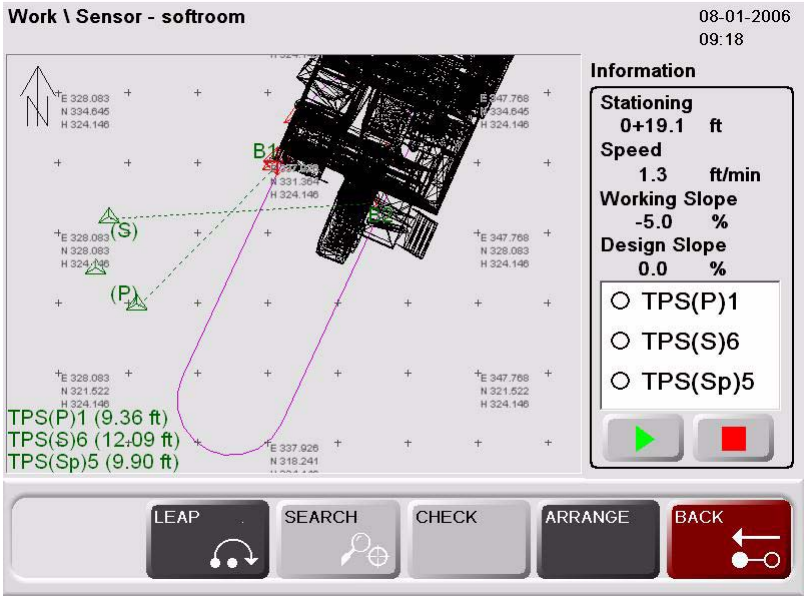


Swapping TPS - making a leapfrog

**Work \ Sensor \ LEAP **

The leapfrog function is a fully automated process. The operator must hold down the **<LEAP>** button for 1 second to start the process. The "Leap" function is disabled if all required sensors are not available. Check the Sensor arrangement (Sensors \ Arrange).
If a required TPS sensor is not visible in PaveSmart 3D, first check the instrument is switched on, correctly positioned/orientated, then verify the battery condition and cabling, and finally that required radio communication settings are correct.

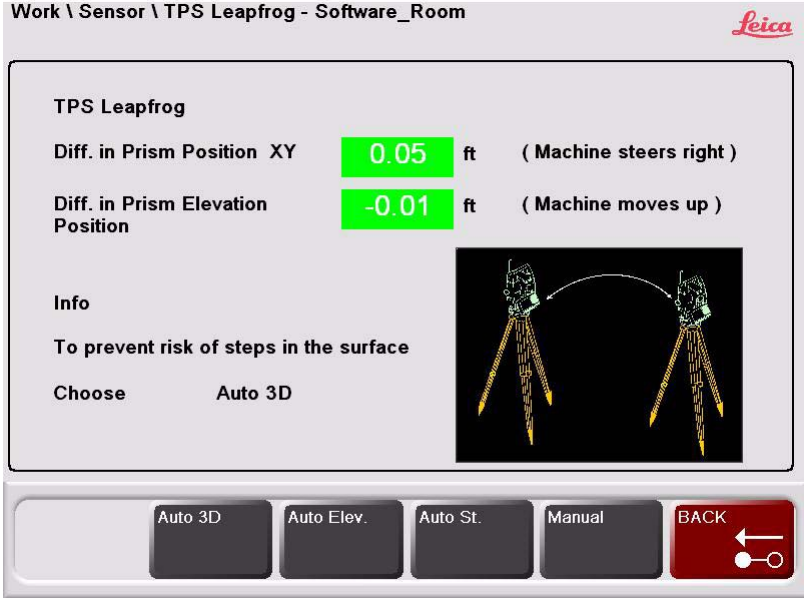
The system automatically removes the required instrument (nearest or furthest measuring) out of active control and sets it to the spare sensor, replacing it with the instrument previously in the spare sensor location.



Before leapfrogging a TPS instrument, the machine must be at a stand-still. If the machine is moving the spare instrument may not be able to lock onto the prism and erroneous measurements may result.

Changing the offset to the design

After calculating the deviation between the Active TPS and the Spare TPS, the offsets to the design may need to be altered to prevent any steps or lines appearing in the concrete. This occurs before the Spare TPS takes active control of the machine. "Steps" may be introduced due to minor changes/errors in the positions/orientations of the total stations - the accuracy of the instrument position/orientation is heavily dependent on the quality and location of the local site reference points.



Auto 3D Offset adjustment

Work \ Sensor \ Leapfrog \ Auto 3D

<Auto 3D> changes the current working offsets by subtracting the deviation between the current position and the new position from the current working offsets in both steering (front and rear) and elevation (front and rear) so no steps appear in the concrete.

Auto 3D is the recommended method of adjusting offsets when an instrument is taken out of active control.
Care must be taken to manually remove this small offset changes if absolute position control is important.

Auto Elevation Offset adjustment

Work \ Sensor \ Leapfrog \ Auto Elev.

The Auto Elevation button will change the elevation offsets by the difference in height between the active measurement and the new measurement at the front and rear of the mold.
The steering offsets will remain as they were before the instrument swap.

Auto Steer Offset adjustment

Work \ Sensor \ Leapfrog \ Auto Steer

The Auto Steer button will shift the position in the front and rear steer offsets by the difference between the existing deviation to the reference line and the new deviation to the reference line. The elevation offsets will remain as they were before the instrument swap.

Manual Offset adjustment

No change is made to the offsets. The operator is required to make any changes in the offsets manually.

2.10 Checking Instrument Setup Quality and Status

When to check?

Observing survey best practice is the key to maximum system accuracy with Leica PaveSmart 3D. Poorly positioned or orientated instruments may have a serious effect on product quality.
This procedure should be carried out regularly, ideally during breaks in machine operations, e.g. waiting for concrete, to ensure no undetected movement of the total stations has occurred (e.g. due to excessive vibrations, bad sub-ground under the tripod, high wind, temperature cycling effects etc). This is also very important when the instrument has been standing for a long time (e.g. > 2 hr) at the same setup.

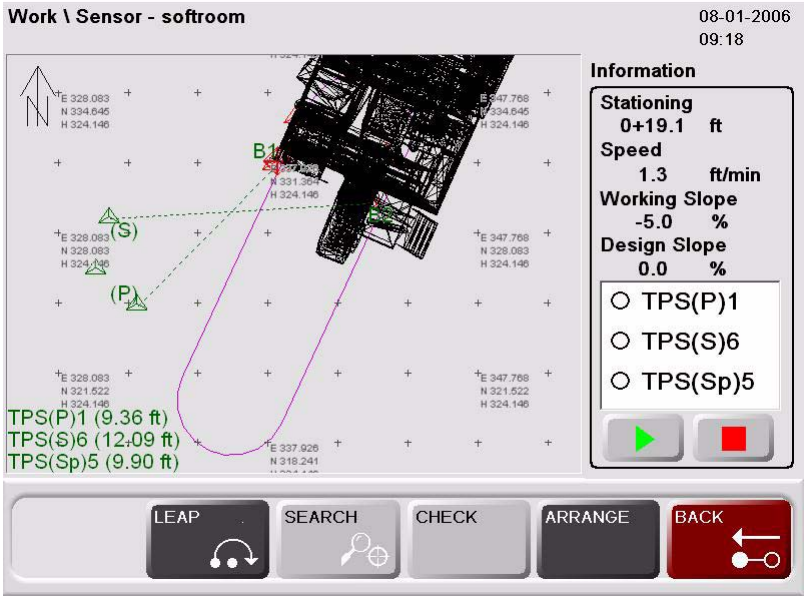
TPS1200+ instruments

☞ **The fixpoint (reference point) job for the TPS1200+ setup is only stored on the instrument. During the TPS setup process (Free Station/Resection or Known Point & Orientation) the user has to preselect the desired fixpoint job in the MGuide application. Please refer to the MGuide User Manual for further information about working with Fixpoints.**

Using the Tiepoint Check function from the **Work** dialog press **SENSOR** and define the instrument with should be verified.

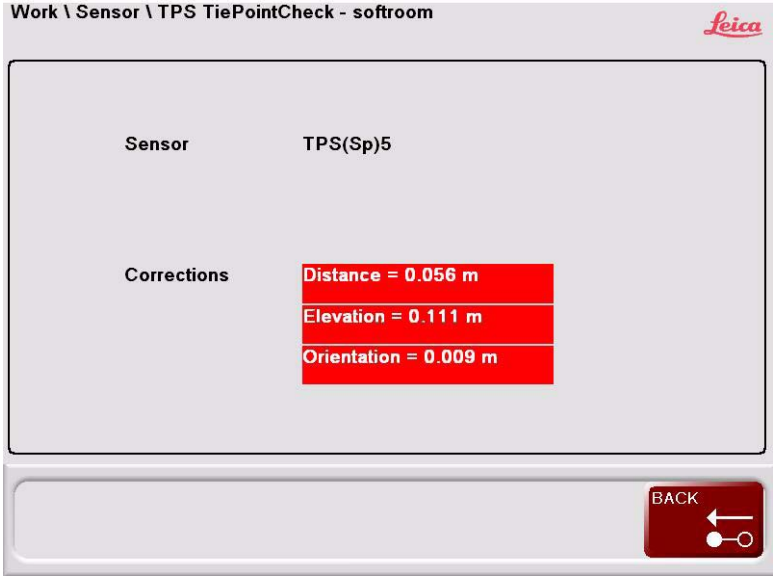
☞ Refer to the MGuide 1200 User Manual Chapter 5 for further details. TPS1200+ can only measure to the predefined point from the fixpoint job (see MGuide 1200 User Manual page 4-15). The horizontal-, distance- and height accuracy settings are also defined in the same TPS1200+ dialog. Customers using PowerTracker instruments refer to the PowerTracker User Manual and the Geo Pad User Manual or Site Foreman User Manual on how to check the instrument setup quality.

Tiepoint Check



After the selection of the instrument press **CHECK**
Attention: The Tiepoint Check can be only used with the TPS not with GNSS.

Wait for the results to be displayed - this will take **several seconds** as the instrument turns to the required position and measures the prism. The instrument will then return to its previous position. The result is displayed after the TPS measurement to the preselected fixpoint. If the result is within the tolerance the Correction is displayed with a green background color.



- If one predefined tolerance is exceeded the result of the Tiepoint Check is displayed with a red background color.
- If the tolerance of one result is too big, a new setup of the TPS1200+ instrument is strongly recommended.
- If no measurement is possible, an error message will be displayed. Check the communication, the TPS1200+ target line and the TPS1200+ settings.

Tie point check function is not available for RedLine instruments.

Checking the Status of GNSS (GPS / GLONASS)

In **Menu: Sensors \ GNSS** the following status information is available:

The machine operator enters in the **<Position Quality:>** the maximum value for the position tolerance and in the **<Height Quality:>** the maximum value for the height tolerance. As soon as these values are exceeded, an error message is sent to the dashboard.

<Firmware version:> shows the current firmware version on the GNSS (GPS / GLONASS) sensor.

<Timestamp:>, the current GNSS time is indicated here.

The number of satellites, which are theoretically available are listed in **<#sats available:>**. Out of these a certain number of satellites are sending data to the GNSS (GPS / GLONASS) receiver **<#sats tracked:>**.

<HDOP:>, **<VDOP:>** and **<Status:>** are geometrical values about the satellite constellation. From those values the **<Pos Quality:>** and the **<Height Quality:>** are calculated.

<Easting:>, **<Northing:>** and **<Height:>** are the coordinates of the current sensor position.

and

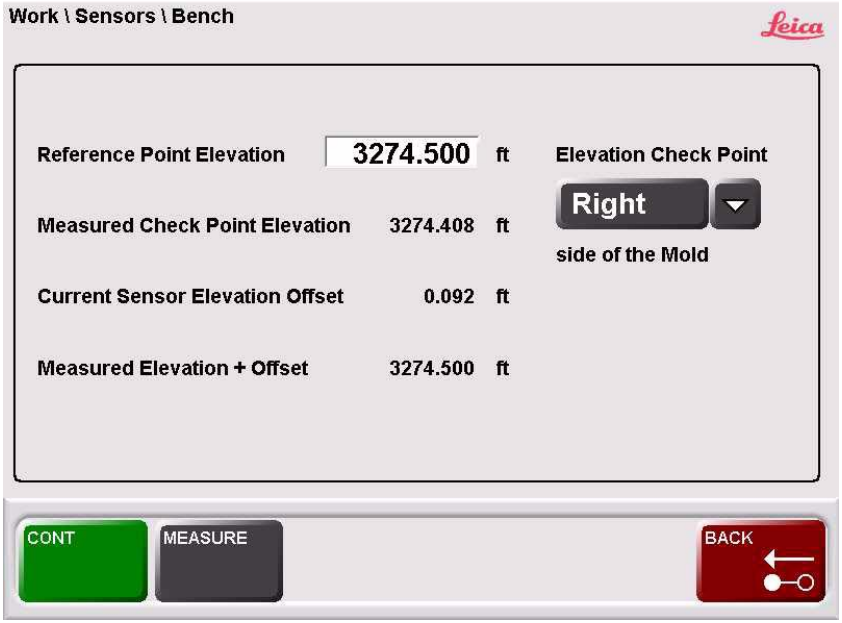
are used to switch between the different sensors.

the **<Position Quality:>** and **<Height Quality:>** are set to the default values.

Benching for GNSS (GPS / GLONASS)

In the **Work: Sensors** dialog when you select a GNSS (GPS / GLONASS) sensor from the instrument list the Bench button becomes active:

open the following dialog:



By selecting the **<Elevation Check Point: Right>** you have chosen the right side of the milling head for the elevation check. Other options are: **<Elevation Check Point: Center>**

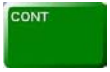
and **<Elevation Check Point: Left>**. The selected spot on the milling head is then measured or brought directly in relation to the control point hub.

The **<Reference Point Elevation>** is manually entered by the operator.

the sensor starts measuring. This may take a few seconds as several measurements are taken during this time.

The **<Measured Check Point Elevation>** is the current elevation of the milling head, measured with the GNSS (GPS / GLONASS) sensor.

The difference between the measurement and the reference point elevation is the **<Current Sensor Elevation Offset>**.



continues and accepts the current sensor elevation offset. From now on this offset is considered in the calculation until a new offset is determined with the Bench function again.

continues and rejects the currently determined offset. The before used offset will be used again.

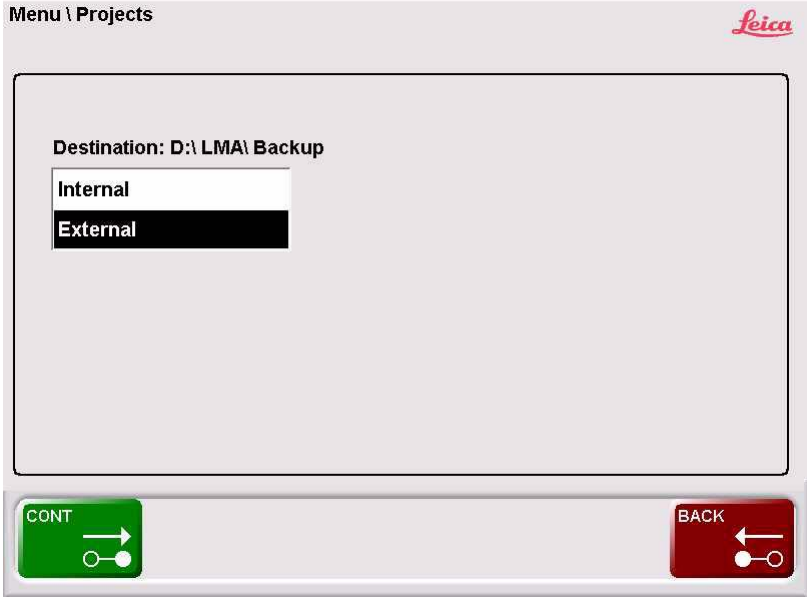
2.11 Backup and Restore

the Backup button is only active if PaveSmart 3D is in the Config level.

Creating a Backup

A PaveSmart 3D Backup contains all projects, all logfiles and all current software settings. It can be used to re-establish a certain state on the machine computer for trouble shooting purposes. The Backup is also very useful to check the current state for service purpose. For example the user can send a Backup to the Leica service personnel to detect a problem.

In the dialog **Menu: Projects \ Backup** the operator chooses **<Backup>** to get to the following dialog:

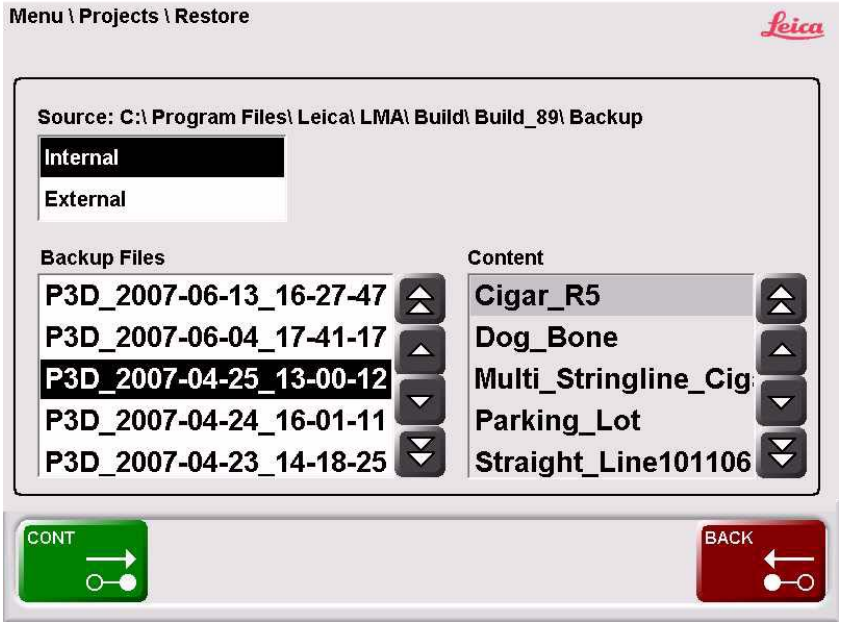


An **<Internal>** Backup is stored on the local drive on the machine computer.
An **<External>** Backup is stored on the external USB storage device.

To create a Backup may take up to a few minutes, depending on the amount of data that's stored on the machine computer. When finished a confirmation message will be shown. In this message the file name of the Backup zip-file is displayed.

Restoring a Backup

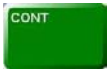
In the dialog **Menu: Projects \ Backup** the operator selects **<Restore>** to get to the following dialog:



There are two sources for the restore process: **<Internal>** is the local storage on the machine computer and **<External>** is the external USB storage device.

The **<Backup Files:>** of the selected source are shown in a list. The latest Backup is always on the top.

In the **<Content>** window all the projects of the currently selected Backup file are listed.



restores the selected Backup and overwrites all projects, all logfiles and all current software settings. Before the current settings and data are over-written, an internal Backup is automatically done.

2.12 Stopping Work (End of Daily Production)

After Production

To Stop Tracking, press and hold Stop for one second.
The Stop button now displays **Exit**. Press and hold **Exit** for more than 1 second to display the Shutdown/Restart options dialog. Select **Shutdown** to exit PaveSmart 3D and power-off the MPC1310.

Do not power off the MPC1310 by holding down the Power Key! Always shut down the MPC1310 by using the Exit button to ensure all important project data are saved. Incorrect shutdown of the MPC1310 may risk unexpected data loss or corruption of the Windows system files!

After approx. thirty seconds when the MPC1310 display is black, turn off power using the power key.
Disconnect power/data cables, radio cables.
Store all equipment in the MPC1310 carrycase.
Fit dust/water caps for machine-mounted connectors, if provided, to prevent rain or condensation build-up which may lead to electrical problems.

Due to the risk of theft, lightning-strikes or vandalism, we strongly recommend removal of the radios, GNSS and MPC1310 computer overnight.

3 System Components, Diagrams, Software Description

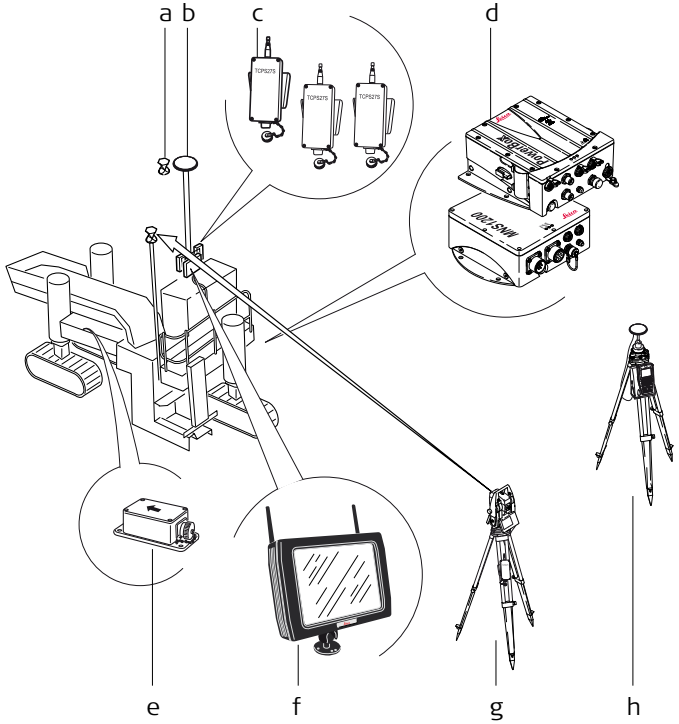
3.1 Hardware Descriptions

General information

Even though the hardware components are designed for rough conditions, the components have to be treated and transported in a careful manner. Therefore use the designated packaging for transport and study the relevant documentation for cleaning and maintenance work (refer to "5 Care and Transport").

System hardware

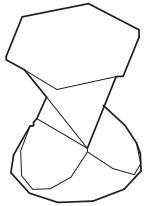
The installed components on the machine comprise a Machine Computer with attached radio modem(s) to communicate with the Total Station(s), dual slope sensor, mast(s) with attached reflector or optional GNSS (GPS / GLONASS) antenna. As well as the installed components on the machine, Total Station(s) with radio modem(s) need to be set up. In case of the GNSS (GPS / GLONASS) option without an available correction signal, a reference station set up is additionally required.



a) Reflector
b) GNSS antenna
c) TCPS27S or FreeWave radio modem('s)
d) GNSS sensor
e) Slope sensor
f) MPC1310
g) Total Station(s) with radio modem(s)
h) GNSS reference station

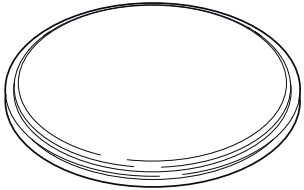
For further details on each component listed below, refer to the reference manual and/or the component specific manuals.

Reflector



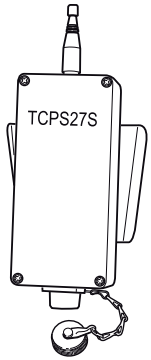
MPR122, 360° Reflector PRO, for machine automation.

GNSS



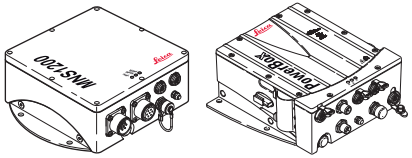
The MNA1202 GG antenna mounted on the secondary mast of the machine.

TCPS27S Radio Modems



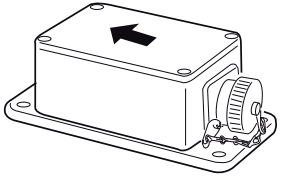
Except North Americas, TCPS27S radio modems with ITT Cannon connectors are used on the machine, and communicate with the TPS1200+ Radio Handle mounted onto the instrument.
For further information refer to the TCPS27 user manual.

GNSS sensor (GPS / GLONASS)



The GNSS option uses the MNS1230 machine navigation sensor (GNSS) or the PowerBox (GNSS) with power protection and mil-connectors.
For further information refer to the Leica MNS1200 user manual or the Leica GNSS Machine Positioning user manual.

Slope sensor

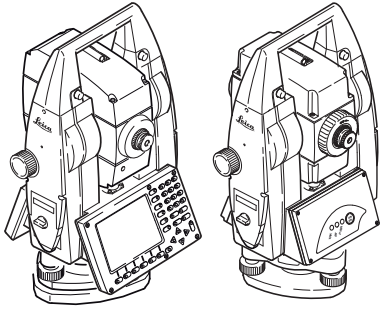


One dual axis slope sensor with a CAN interface is used. Mounted in the middle of the machine at the rotation point.
For further information refer to the Dual Slope user manual.

Machine Computer

The MPC1310 is a ruggedised computer with Windows XP Embedded, touchscreen, milspec connectors for power, CAN, four serial (RS232) and USB interfaces. Bracket to mount Machine Computer for easy installation and removal at the end of the day, a power supply for office preparation, a carry-case and a USB CF-Card adapter are all supplied as part of the MPC1310 package.
For further information refer to the MPC1310 user manual.

Total Station(s)



The system supports TPS1200+ Total Stations with the OnBoard software application MGuide and it supports the Leica PowerTracker instruments. The radio modem is optionally integrated into the handle of the instrument. For further information refer to the TPS1200+ user manual or the PowerTracker user manual.

Further Hardware

For further details on each component listed below, refer to the technical reference manual and/or the component specific manuals.

3.2 System Wiring Diagrams

General information

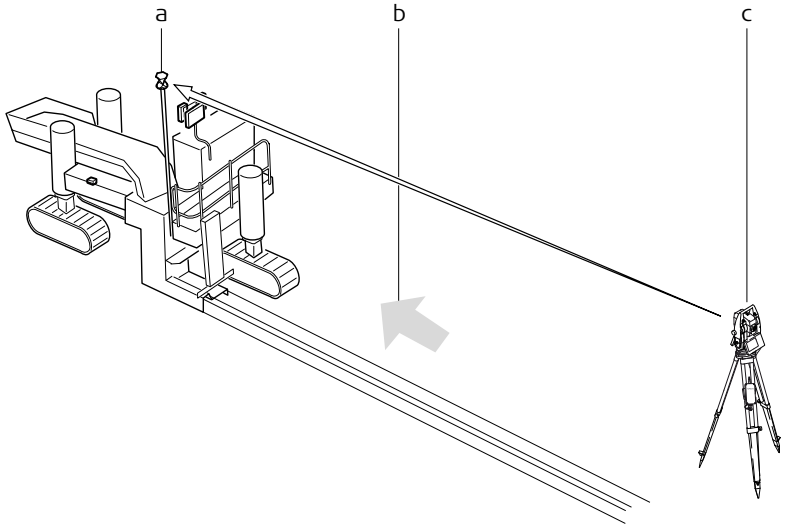
The system wiring is dependent on the purchased / installed solution. The main installation is identical, only the serial port sensor combination may vary depending on the sensor equipment used. It is possible to attach up to 4 Total Stations and a GNSS sensor.

- The MPC1310 must be mounted with the bracket supplied. The rear of the MPC1310 should be free from obstructions to allow sufficient cooling.
- Mast(s) must be fixed firmly to the frame of the machine so minimum vibration is experienced.
- Slope sensors must be mounted at the rotating point of the machine with the arrow facing forward direction of travel.
  Use the machine-manufacturer-supplied slope sensor mounting bracket wherever possible.
- Where applicable: Alternatively to the TCPS27S rugedised radio modems, approved 3rd party radio modems, such as Freewave, with appropriate cables can be used. Refer to the Leica PaveSmart 3D Technical Reference Manual for machine specific details.

1-Prism solution

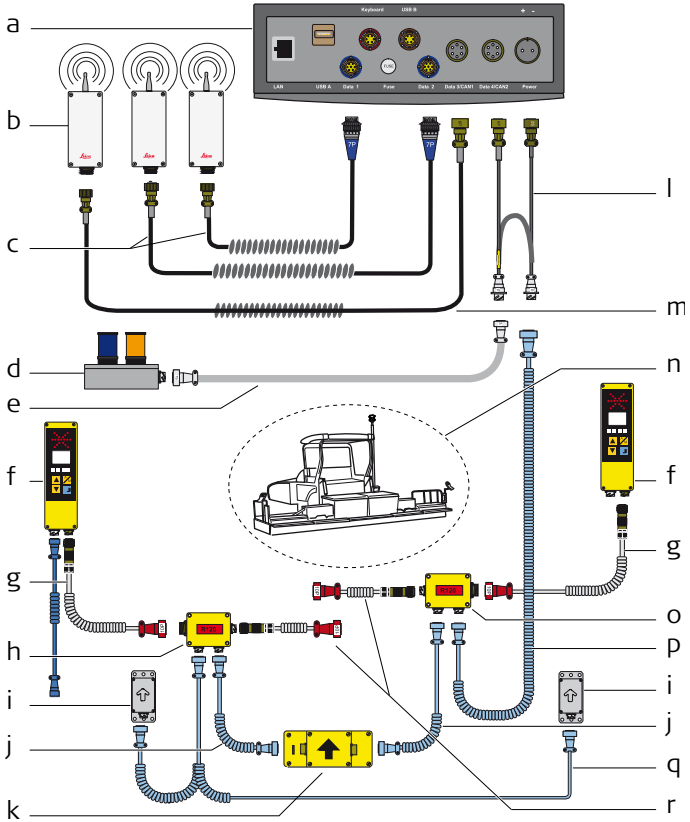
The one prism solution uses one TPS instrument for continuous tracking of the machine. A second optional TPS instrument can be attached for leapfrogging and/or as-built measurements.

This can only be used with "one track steer" machines, such as Gomaco GT3200 series curb & gutter/offset paver, Gomaco PS2600 placer-spreaders, or PowerCurber 5700 series offset pavers, or where the steer function rear track(s) of an all-track-steer machine are disabled (ensure to verify track angle is perfectly parallel to the machine travel direction otherwise poor paving quality will result!).



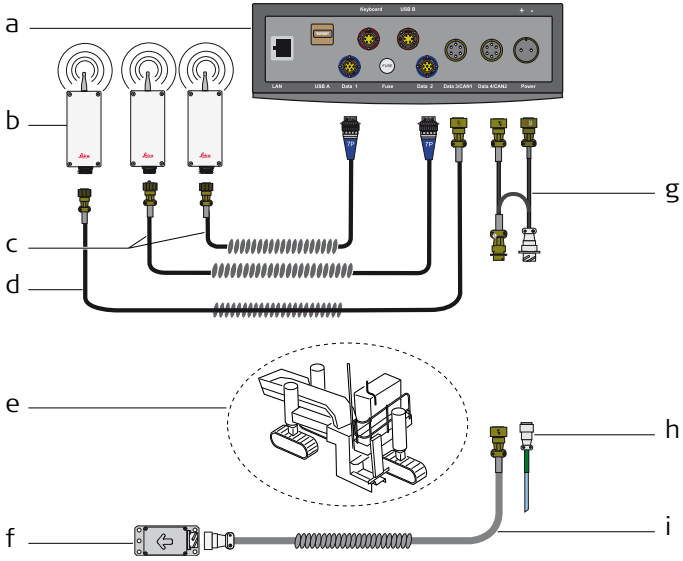
a) Mast Position Primary reflector (B1)
b) Direction of travel
c) TPS Instrument

System components for MOBA-matic or Wirtgen DLS/LevelPro equipped Road Paver and Milling machine:



a) MPC1310
b) TCPS27S radio modems
c) PWM cables for serial connection(s) to TCPS27S
d) Alarm box
e) CAN cable to alarm box
f) MOBA-matic controller
g) Cable MOBA-matic controller to junctionbox
h) Junctionbox Left
i) Dual-axis slope sensor
j) CAN cable slope sensor to junctionbox
k) Slope sensor CAN
l) H-cable Power / CAN connection, machine specific
m) PWM cable for serial connection (COM3) to TCPS27S
n) Road Paver machine
o) Junctionbox Right
p) CAN Cable to connect junctionbox
q) Y-CAN cable to connect slope sensor
r) Connector cable to machine, machine-specific

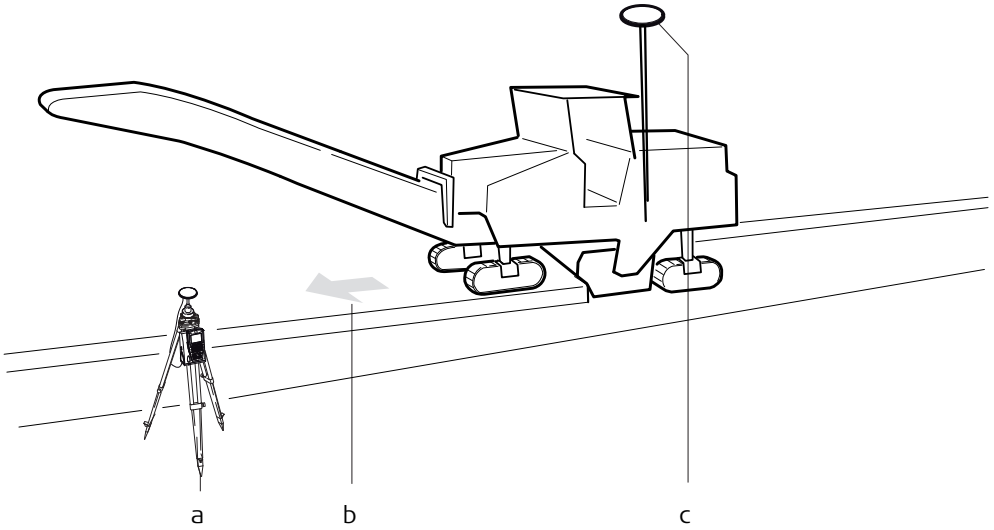
System components for Curb and Gutter/Offset paving machine:



a) MPC1310
b) TCPS27S radio modems
c) PWM cables for serial connection(s) to TCPS27S
d) PWM cable for serial connection (COM3) to TCPS27S
e) Curb and Gutter machine
f) Dual-axis slope sensor
g) H-cable Power / CAN connection, machine specific
h) Cable to machine, usually supplied by machine manufacturer as part of 3D Kit
i) CAN cable slope sensor to MPC1310

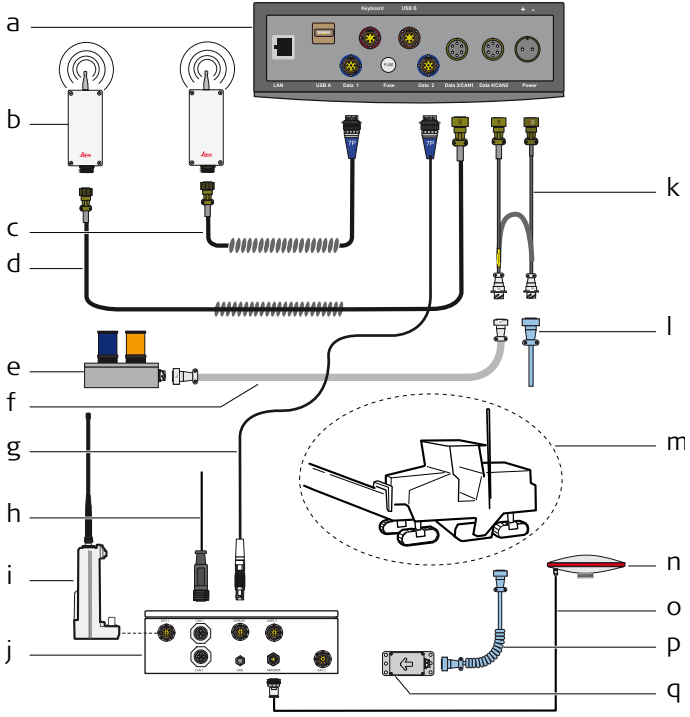
1-GNSS solution

The one GNSS solution uses one GNSS sensor for continuous tracking of the machine. An optional TPS instrument can be attached for as-built measurements:



a) GNSS reference station
b) Direction of travel
c) Mast Position GNSS antenna Primary (B1)

System components for Wirtgen- or MOBA equipped milling machines:



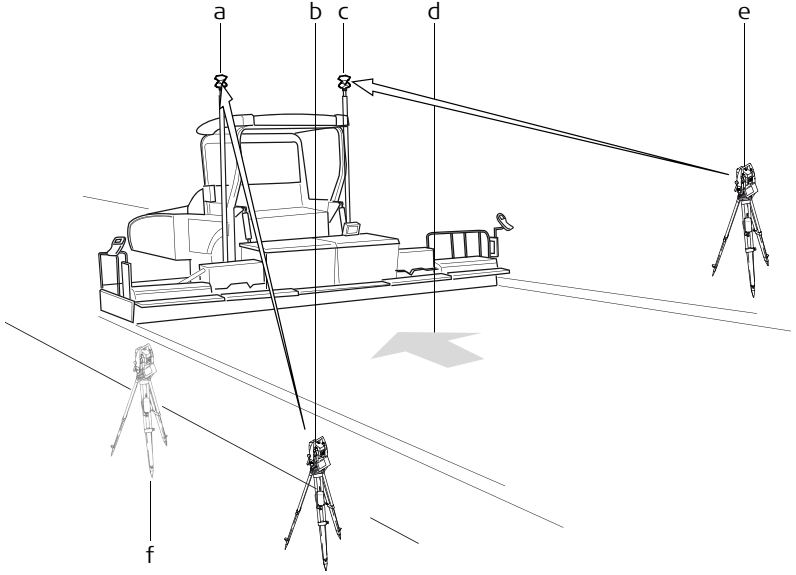
a) MPC1310
b) TCPS27S radio modems
c) PWM cable for serial connection to TCPS27S
d) PWM cable for serial connection (COM3) to TCPS27S
e) Alarm box
f) CAN cable to alarm box
g) Cable MPC1310 to PowerBox
h) Cable PowerBox to machine battery
i) SATELLine or Freewave radio
j) PowerBox GNSS sensor
k) H-cable Power / CAN connection, machine specific
l) Cable to machine, usually supplied by machine manufacturer as part of 3D Kit
m) Milling machine
n) GNSS antenna
o) Antenna cable
p) CAN cable to connect slope sensor
q) Dual-axis slope sensor

The controls are normally an integral part of the machine. The components are connected directly to the standard (or optional) machine junctionbox and communication cables are connected via the machine's own CAN bus.

2-Prism solution

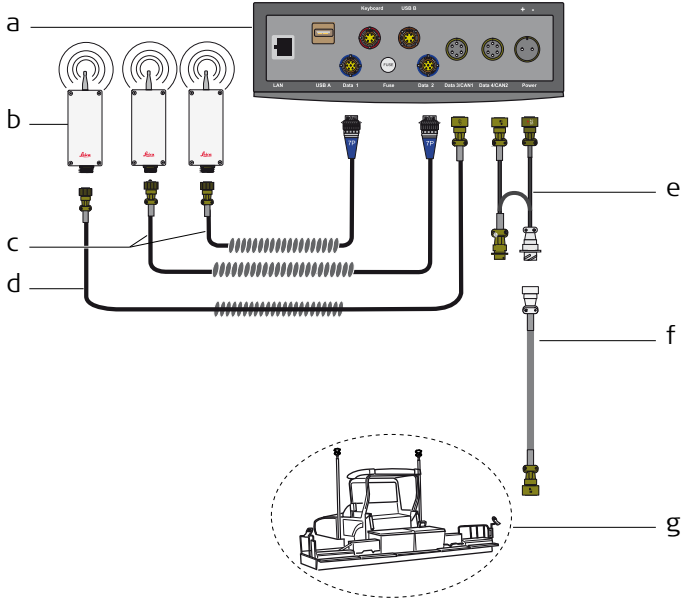
The two prism solution uses two TPS instruments for continuous tracking of the machine. A third optional TPS instrument can be attached for leapfrogging and/or as-built measurements.

For tracked Voegele roadpavers equipped with the latest NaviTronic system, this arrangement can also regulate automatic steering direction of the machine. Please refer to Voegele for details of NaviTronic autosteer-compatible machines.



a) Mast position Primary reflector (B1)
b) TPS Instrument
c) Mast position Secondary reflector (B2)
d) Direction of travel
e) TPS Instrument
f) Spare TPS (for as-built and leapfrog)

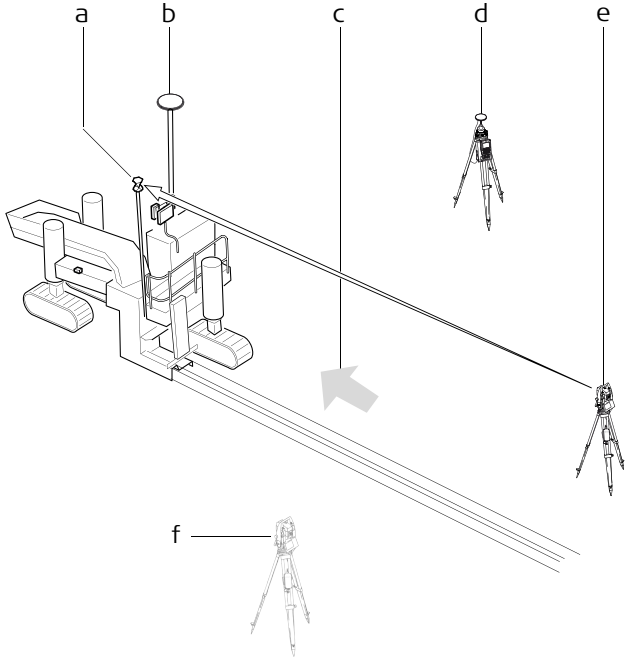
System components for Vögele Road Paver machine:



a) MPC1310
b) TCPS27S radio modems
c) PWM cables for serial connection(s) to TCPS27S
d) PWM cable for serial connection (COM3) to TCPS27S
e) H-cable Power / CAN connection, machine specific
f) Machine connection cable
g) Road Paver machine

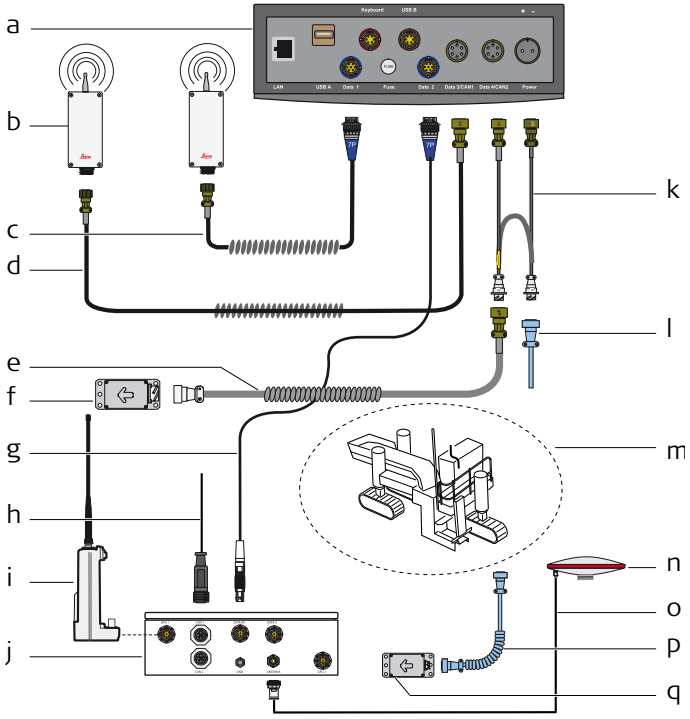
GNSS-Prism solution

The GNSS-Prism solution uses one TPS instrument and a GNSS (GPS/GLONASS) sensor for continuous tracking of the machine. A second optional TPS instrument can be attached for leapfrogging and/or as-built measurements:



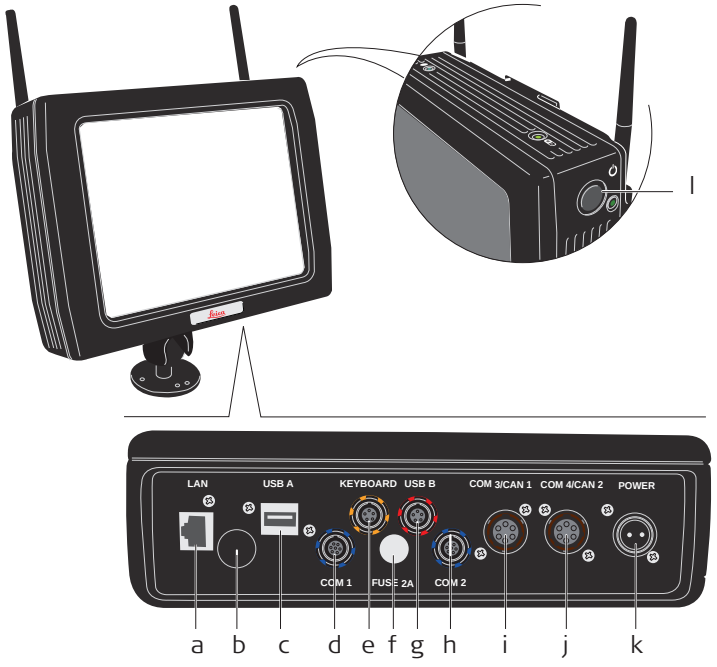
a) Mast Position Primary Reflector (B1)
b) Mast Position GNSS antenna Secondary (B2)
c) Direction of travel
d) GNSS reference station
e) TPS Instrument (Primary)
f) Spare TPS (for as-built and leapfrog)

System components for Curb and Gutter machine:



a) MPC1310
b) TCPS27S radio modems
c) PWM cable for serial connection to TCPS27S
d) PWM cable for serial connection (COM3) to TCPS27S
e) CAN cable to connect slope sensor
f) Dual-axis slope sensor
g) Cable MPC1310 to PowerBox
h) Cable PowerBox to machine battery
i) SATELLine or Freewave radio
j) PowerBox GNSS sensor
k) H-cable Power / CAN connection, machine specific
l) Cable to machine, usually supplied by machine manufacturer as part of 3D Kit
m) Curb and Gutter machine
n) GNSS antenna
o) Antenna cable
p) CAN cable to connect slope sensor
q) Dual-axis slope sensor

MPC1310



a) LAN connector
b) Ventilation cap
c) USB A Host connector
d) COM 1 port
e) Keyboard connector
f) 2A fuse for outgoing power
g) USB B Device connector
h) COM 2 port
i) COM 3/CAN 1 port
j) COM 4/CAN 2 port
k) Power connector
l) Power key

USB

USB connection, Leica Geosystems USB storage device or standard USB keyboards recommended only.

Never remove the USB storage device until file read/write/copy operations are completed, as this may cause file loss or corruption.

Do not attach any USB device which needs additional driver installation, as this may cause configuration corruption or installation **problems**.

COM 1, 2, 3, *4*	Serial Ports for Radio Modem connection to Total Station and connection to GNSS sensor. Power output voltage: regulated +13.6 V
CAN 1, 2	CAN bus connection.
POWER	Power in, 10-36 volt DC, reverse polarity protected.
Power key	To turn On and Off the Machine Computer.
⚠ **Caution**	Never turn Off the Machine Computer without shutting down all running applications. This could result in unexpected data loss! **Precautions:** Black screen must be displayed after pressing the Shutdown button in Leica PaveSmart 3D software before switching the power off to the MPC1310.
KEYBOARD	Permits connection of external keyboards with compatible LEMO connectors. Contact Leica Geosystems for further information.

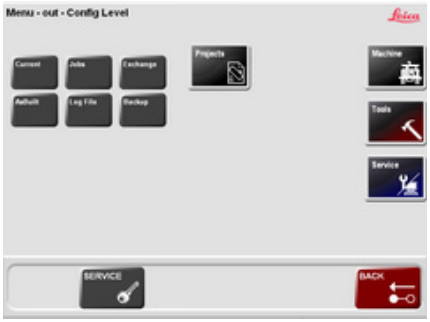
3.3 Software Description

General

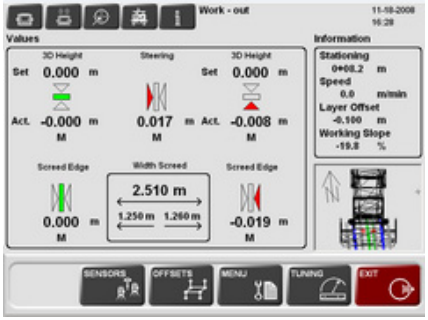
PaveSmart 3D is a machine control application for paving and milling machines. The system software controls the steer-, elevation- and slope control loop of the machine.
The 3D design model is loaded onto the Machine Computer. The software compares the actual position of the machine with the design. The actual position is calculated with attached System 1200 tracking data and the slope sensor mounted onto the machine. The calculated deviations are then according to the control parameters transformed into variables for the hydraulic, which are sent via CAN bus to the machine controller. Therefore the sensitivities on the machine controller have to be deactivated or set to zero unless advised otherwise by a Leica Geosystems or machine manufacturer authorised support engineer.

Menu Structure

Password for configuration level
Default Config password = 007



Menu in configuration level; all buttons accessible



Work screen

Dialogs

Refer to "2.2 Operating the MPC1310 Machine Computer" for more information about the Work and the Menu dialog.

4 Troubleshooting

Troubleshooting

Problem	Possible cause(s)	Suggested remedies
Computer does not boot or start up or keeps rebooting	Inadequate or missing power supply Power regulator failed Reversed power supply polarity	Check machine power supply, fuses and voltage regulator Check connections to the MPC1310
	Damaged Machine Computer	Contact Leica Geosystems
	Damaged power cable	Check all cables for damage
Leica PaveSmart 3D does not start	Auto-Start is not enabled Configuration corrupted	Restore Auto-Start link Copy backup from USB storage device
Configuration is lost or strange behaviour of Leica PaveSmart 3D	Configuration corrupted	Restore back up in the Projects menu
Total Station fails to initialise	Communication parameters on instrument are not set correctly Baud rate is not identical on instrument and in the software	Choose appropriate Conig Set (TCRP RCS-RH1200 or TCRP RCS-TCPS27) Green LED's on a radio modem pair need to be On
	Radio modems have not the same Link / baud rate configuration	Configure radio modems to the same the same Link / baud rate configuration
	• Low battery at instrument	• Instrument is in a configuration menu or in As-Built menu

Problem	Possible cause(s)	Suggested remedies
	• Radio interference or cabling damaged • MGuide is not installed • Low power at machine	• Install MGuide application and choose appropriate Config Set • Contact Leica Geosystems • Ensure the radio handle is on the correct way with the lights facing the operator and the antenna facing the paver. • Turn on the paver as power supply may not be sufficient if the paver is not running
Total Station does not react on commands	• MGuide application is in configuration mode • MGuide is in As-Built dialog • Auto-Shutdown at instrument	• Change to MGuide main menu • Solve instrument error message (refer to TPS1200+ manual) • Unplug power cable and restart instrument
GNSS sensor is not initialised	• Communication parameters on sensor are not set correct • Baud rate is not identical on instrument and in the software	• Set correct Config Set on sensor • Check communication parameters on sensor • Contact Leica Geosystems
GNSS position accuracy is bad	• Wrong transformation file loaded • No reference signal available • Bad satellite distribution • Not enough satellite available	• Check transformation file on sensor • Check reference signal • Contact Leica Geosystems • Check radio configuration between MNS and base station

Problem	Possible cause(s)	Suggested remedies
Leica PaveSmart 3D is not reacting to user input via touchscreen or keyboard	• Flash disk is full • System has crashed	• Remove unnecessary Jobs or log files • Reboot computer
Strange behaviour - machine lifts legs incorrectly and/or drives off steering line	• Slope sensor incorrectly orientated/adjusted • Total Station incorrectly oriented • Machine not in Leica/Automatic mode • Hydraulic tuning not appropriate	• Check installation and readjust slope sensor as required • Perform a Tiepoint check to verify Total Station orientation (if necessary new Resection) • Check Machine Controller all control loops must be in automatic.
Strange steering behaviour when Leica PaveSmart 3D is sending correct values to machine	• Steering in Manual Mode on machine panel • Tracks/feedback pots incorrectly adjusted	• Set Steer for each Leg into Automatic • Check and readjust machine steering as required
Nervous over-reactive steering behaviour	• Steering Sensitivity too high	• Set Steer Sensitivity to Minimum on machine panel • Adjust steer tuning parameters

Problem	Possible cause(s)	Suggested remedies
System starts Tracking, but no deviations are displayed on screen and dash-board blinks	• System has detected a problem and stops for safty • Wrong prism targeted or wrong moving prism as-signed to Total Station • Wrong reference line of Job activated in Design dialog • Machine is outside the limits of the project	• Check dashboard message • Target correct prism and reas-sign prism to Total Station (B#, only with 2 prism solution) • Perform a Tiepoint check to verify Total Station orientation (if necessary new Resection) • Check loaded Job and assigned reference line • Drive the machine within the design extents manually
Dashboard blinks red continuously	• Tolerances exceeded	• Press dashboard button and check error message
Machine stops, all deviations are shown as "-" or error	• Wrong Job or reference line is loaded in the Job dialog • Machine is out of project	• Check in the Job dialogue to see which design is selected • Check the assigned reference line • Check Offsets
System is tracking OK but machine does not move	• Stop rule is active and machine is outside of the defined toler-ance range	• Deactivate Stop rule and drive machine to design position • As a short term measure, devia-tion can be reduced with the offset and the machine driven to the design position • Care must be taken to re set stop rules

Problem	Possible cause(s)	Suggested remedies
Position offsets are wrong	• Wrong Job or reference line is chosen • Offsets are wrong	• Check the chosen Job in the Job dialog • Check the chosen reference line • Check the steering offsets
Slopes and elevations become gradually imprecise while paving	• After paving for a long period the geometry of the machine may change (mold settles, wear and tear, vibration etc.) • Instrument adjustment drift	• Check and readjust mold slope sensor regularly • Readjust Total Station(s)
No log files saved	• Disk space full • Log files have not been properly activated	• Delete unnecessary data in the Manage dialog
Strange behaviour - wrong machine pa-rameters saved	• System crashed (power supply)	• Close system. Restore the configuration settings.
Machine start to undulate during paving	• Too much head of concrete or sub grade in front of machine • Hydraulic lift pressure incorrect	• Reduce head of material, refer to machine manual, check hydraulic system

Problem	Possible cause(s)	Suggested remedies
Machine height is controlled in wrong direction e.g. correction up -> machine goes down and vice versa	• Hydraulic tuning parameters incorrect • Slope sensor mounted in the wrong direction	• Contact Leica Geosystems • Reset the default tuning parameter in elevation and Steer. Retune machine before paving
TPS or GNSS Battery does not hold charge	• Battery has previously only been partially discharged before recharging • Suffering from memory effect	• Refer to the charger manual for discharge/recharge cycle instructions

5 Care and Transport

5.1 Transport

Transport in the field

When transporting the equipment in the field, always make sure that you carry the product in its original transport container.

Transport in a road vehicle

Never carry the product loose in a road vehicle, as it can be affected by shock and vibration. Always carry the product in its transport container and secure it.

Shipping

When transporting the product by rail, air or sea, always use the complete original Leica Geosystems packaging, transport container and cardboard box, or its equivalent, to protect against shock and vibration.

5.2 Storage

Product

Respect the temperature limits when storing the equipment, particularly in summer if the equipment is inside a vehicle. Refer to the "7 Technical Data" chapter for information about temperate limits for each component. This information may be contained in the component specific manual.
It is always recommended to store the MPC1310 and total stations in their supplied cases, protected against influences of the weather during longer working breaks (e.g. overnight, at weekends).

5.3 Cleaning and Drying

General

Use only a clean, soft, lint-free cloth for cleaning. If necessary, moisten the cloth with water or pure alcohol.
Do not use other liquids; these may attack the polymer components.

Damp products

Dry the product, the transport container, the foam inserts and the accessories at a temperature not greater than 40°C / 108°F and clean them. Do not repack until everything is completely dry.

Cables and plugs

Keep plugs clean and dry. Blow away any dirt lodged in the plugs of the connecting cables.

Connectors with dust caps

Wet connectors must be completely dry before attaching the dust cap.

5.4 Maintenance

Control measurements

During paving or trimming, control measurements must be made regularly to determine possible changes in the machine geometry or in the sensors. Paving or trimming accuracy is influenced by jobsite conditions such as temperature, visibility and material consistency and can be adjusted through offsets.

6 Safety Directions

6.1 General

Description

The following directions should enable the person responsible for the product, and the person who actually uses the equipment, to anticipate and avoid operational hazards. The person responsible for the product must ensure that all users understand these directions and adhere to them.

6.2 Intended Use

Permitted use

- Guidance of construction machines by means of the position signals (The subordinated machine control system has to provide all safety functions. This machine control system has to be checked prior to placing it into operation).
- Contact-free determination of the position of construction machines
- Computation and evaluation of data by means of software
- Visualisation of the data
- Recording of data

Adverse use

- Use of the product without instruction.
- Use outside of the intended limits.
- Disabling safety systems.
- Removal of hazard notices.
- Opening the product using tools, for example screwdriver, unless this is specifically permitted for certain functions.
- Modification or conversion of the product.
- Use after misappropriation.
- Use of products with obviously recognizable damages or defects.

- Use with accessories from other manufacturers without the prior explicit approval of Leica Geosystems.
- Inadequate safeguards at the surveying/working site, for example when measuring on roads.
- Controlling of machines, moving objects or similar monitoring application without additional control- and safety installations.

Warning

Adverse use can lead to injury, malfunction and damage. It is the task of the person responsible for the equipment to inform the user about hazards and how to counteract them. The product is not to be operated until the user has been instructed on how to work with it.

6.3 Limits of Use

Environment

Suitable for use in an atmosphere appropriate for permanent human habitation: not suitable for use in aggressive or explosive environments.

Danger

Local safety authorities and safety experts must be contacted before working in hazardous areas, or in close proximity to electrical installations or similar situations by the person in charge of the product.

6.4 Responsibilities

Manufacturer of the product

Leica Geosystems AG, CH-9435 Heerbrugg, hereinafter referred to as Leica Geosystems, is responsible for supplying the product, including the user manual and original accessories, in a completely safe condition.

Manufacturers of non Leica Geosystems accessories

The manufacturers of non Leica Geosystems accessories for the product are responsible for developing, implementing and communicating safety concepts for their products, and are also responsible for the effectiveness of those safety concepts in combination with the Leica Geosystems product.

Person in charge of the product

The person in charge of the product has the following duties:

- To understand the safety instructions on the product and the instructions in the User Manual.
- To be familiar with local safety regulations relating to accident prevention.
- To inform Leica Geosystems immediately if the equipment becomes unsafe.
- To ensure that the national laws, regulations and conditions for the operation of radio transmitters are respected.

Warning

The person responsible for the product must ensure that it is used in accordance with the instructions. This person is also accountable for the training and the deployment of personnel who use the product and for the safety of the equipment in use.
This product may be installed on building machinery only by an appropriately trained and qualified specialist.
Unauthorised modification of machines by mounting the product may alter the function and safety of the machine.

Precautions:
Follow the instructions of the machine manufacturer. If no appropriate instruction is available, ask machine manufacturer for instructions before mounting the product.

6.5 Software Licence Agreement

International Warranty

The International Warranty can be downloaded from the Leica Geosystems home page at http://www.leica-geosystems.com/internationalwarranty or received from your Leica Geosystems dealer.

Software Licence Agreement

This product contains software that is preinstalled on the product, or that is supplied to you on a data carrier medium, or that can be downloaded by you online pursuant to prior authorisation from Leica Geosystems. Such software is protected by copyright and other laws and its use is defined and regulated by the Leica Geosystems Software Licence Agreement, which covers aspects such as, but not limited to, Scope of the Licence, Warranty, Intellectual Property Rights, Limitation of Liability, Exclusion of other Assurances, Governing Law and Place of Jurisdiction. Please make sure, that at any time you fully comply with the terms and conditions of the Leica Geosystems Software Licence Agreement.
Such agreement is provided together with all products and can also be found at the Leica Geosystems home page at http://www.leica-geosystems.com/swlicense or your Leica Geosystems dealer.
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6.6 Microsoft End User License Agreement ("EULA")

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  - **NOT FAULT TOLERANT**. THE SOFTWARE IS NOT FAULT TOLERANT. LEICA GEOSYSTEMS HAS INDEPENDENTLY DETERMINED HOW TO USE THE SOFTWARE IN THE DEVICE, AND MS HAS RELIED UPON LEICA GEOSYSTEMS TO CONDUCT SUFFICIENT TESTING TO DETERMINE THAT THE SOFTWARE IS SUITABLE FOR SUCH USE.
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- **SOFTWARE TRANSFER ALLOWED BUT WITH RESTRICTIONS.** You may permanently transfer rights under this EULA only as part of a permanent sale or transfer of the Device, and only if the recipient agrees to this EULA. If the SOFTWARE is an upgrade, any transfer must also include all prior versions of the SOFTWARE.
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PRODUCT SPECIFIC TERMS

- **RESTRICTED FUNCTIONALITY**. You are licensed to use the SOFTWARE to provide only the limited functionality (specific tasks or processes) for which the DEVICE has been designed and marketed by Leica Geosystems. This license specifically prohibits any other use of the SOFTWARE programs or functions, or inclusion of additional software programs or functions that do not directly support the limited functionality on the DEVICE.
  a) Notwithstanding the foregoing, you may install or enable on the DEVICE systems utilities, resource management or similar software (including without limitation anti-virus software) (collectively, "Support Software") solely for the purpose of administration, performance enhancement and/or preventive maintenance of the DEVICE. You acknowledge and agree that with respect to any Support Software: (i) the Support Software may not be compatible with the SOFTWARE installed on your DEVICE; (ii) no warranty is provided by MS, Microsoft Corporation or their affiliates for any Support Software that you may install on your DEVICE; and (iii) neither MS, Microsoft Corporation nor their affiliates is responsible for technical support of any Support Software you may install on your DEVICE. Please contact Leica Geosystems if you have any questions regarding any Support Software that you are considering installing on your DEVICE.
  b) The DEVICE may use terminal services protocols (such as Remote Desktop Protocol, Remote Assistance or Independent Computer Architecture) to connect or access Applications (as defined below) running on a server; however, these Applications may not run locally on the DEVICE. For purposes of this provision, "Applications" mean software that provides any of the following functionality: consumer or business tasks or processes performed by a computer or computing device, including email, word processing, spreadsheets, database, scheduling, or personal finance.

- **DEVICE CONNECTIONS**. The SOFTWARE may not be used by more than two (2) processors at any one time on the DEVICE. You may permit a maximum of ten (10) computers or other electronic devices to connect via Server Message Block (SMB) to the DEVICE to utilize one or more of the following services of the SOFTWARE: (a) file services, print services, (b) Internet information services and/or (c) remote access (including connection

sharing). The ten connection maximum includes any indirect connections made through "multiplexing" or other software or hardware which pools or aggregates connections. This ten connection maximum does not apply to other uses of the SOFTWARE. Unlimited simultaneous inbound connections are permitted via TCP/IP.

- **CLIENT ACCESS LICENSES**. If you use the DEVICE to access or utilize the services or functionality of Microsoft Windows Server products (such as Microsoft Windows Server 2003), or use the DEVICE to permit workstation or computing devices to access or utilize the services or functionality of Microsoft Windows Server products, you may be required to obtain a Client Access License for the DEVICE and/or each such workstation or computing device. Please refer to the end user license agreement for your Microsoft Windows Server product for additional information.

- **REMOTE DESKTOP FEATURES/NETMEETING/REMOTE ASSISTANCE**. The SOFTWARE may contain NetMeeting, Remote Assistance, and Remote Desktop technologies that enable the SOFTWARE or other applications installed on the DEVICE to be used remotely between two or more computing devices, even if the SOFTWARE or application is installed on only one DEVICE. You may use NetMeeting, Remote Assistance, and Remote Desktop with all Microsoft products; provided however, use of these technologies with certain Microsoft products may require an additional license. For both Microsoft products and non-Microsoft products, you should consult the license agreement accompanying the applicable product or contact the applicable licensor to determine whether use of NetMeeting, Remote Assistance, or Remote Desktop is permitted without an additional license.

- **REMOTE BOOT FEATURE**. Your DEVICE may be enabled with a Remote Boot feature which includes the Remote Boot Installation Service tool. You may (i) use the Remote Boot Installation Service tool to install one (1) copy of the SOFTWARE onto your server solely for the purpose of deploying the SOFTWARE to one or more DEVICEs on which you

are licensed to run the SOFTWARE (i.e. DEVICEs to which the appropriate Certificate of Authenticity is affixed)); (ii) download the SOFTWARE over your internal network only onto such licensed DEVICEs; and (iii) use the Remote Boot Installation Service only for deployment of the SOFTWARE to licensed DEVICEs as part of the Remote Boot process. Please refer to the DEVICE documentation, if provided with your DEVICE, or contact Leica Geosystems for additional information.

- **AUTOMATIC INTERNET-BASED SERVICES**. The SOFTWARE features described below are enabled by default to connect via the Internet to Microsoft computer systems automatically, without separate notice to you. You consent to the operation of these features, unless you choose to switch them off or not use them. Microsoft does not use these features to collect any information that will be used to identify you or contact you. For more information about these features, please see the privacy statement at http://go.microsoft.com/fwlink/?LinkId=25243
  - **Web Content Features**. Under the SOFTWARE's default configuration, if you are connected to the Internet, several features of the SOFTWARE are enabled by default to retrieve content from Microsoft computer systems and display it to you. When you activate such a feature, it uses standard Internet protocols, which transmit the type of operating system, browser and language code of your DEVICE to the Microsoft computer system so that the content can be viewed properly from your DEVICE. These features only operate when you activate them, and you may choose to switch them off or not use them. Examples of these features include Windows Catalog, Search Assistant, and the Headlines and Search features of Help and Support Center.
  - **Digital Certificates**. The SOFTWARE uses digital certificates based on the x.509 standard. These digital certificates confirm the identity of Internet users sending x.509 standard encrypted information. The SOFTWARE retrieves certificates and updates certificate revocation lists. These security features operate only when you use the Internet.

- **Auto Root Update**. The Auto Root Update feature updates the list of trusted certificate authorities. You can switch off the Auto Root Update feature.
- **Windows Media Player**. Some features of Windows Media Player automatically contact Microsoft computer systems if you use Windows Media Player or specific features of it: features that (A) check for new codecs if your DEVICE does not have the correct ones for content you attempt to play (this feature may be switched off), and (B) check for new versions of Windows Media Player (this feature will operate only when you are using Windows Media Player).
- **Windows Media Digital Rights Management**. Content providers are using the digital rights management technology for Windows Media contained in this SOFTWARE ("WM-DRM") to protect the integrity of their content ("Secure Content") so that their intellectual property, including copyright, in such content is not misappropriated. Portions of this SOFTWARE and third party applications such as media players use WM-DRM to play Secure Content ("WM-DRM Software"). If the WM-DRM Software's security has been compromised, owners of Secure Content ("Secure Content Owners") may request that Microsoft revoke the WM-DRM Software's right to copy, display and/or play Secure Content. Revocation does not alter the WM-DRM Software's ability to play unprotected content. A list of revoked WM-DRM Software is sent to your DEVICE whenever you download a license for Secure Content from the Internet. Microsoft may, in conjunction with such license, also download revocation lists onto your DEVICE on behalf of Secure Content Owners. Secure Content Owners may also require you to upgrade some of the WM-DRM components in this SOFTWARE ("WMDRM Upgrades") before accessing their content. When you attempt to play such content, WM-DRM Software built by Microsoft will notify you that a WM-DRM Upgrade is required and then ask for your consent before the WM-DRM Upgrade is downloaded. WMDRM Software built by third parties may do the same. If you decline the upgrade, you will not be able to access content that requires the WM-DRM Upgrade; however, you will still be able to access unprotected content and Secure Content that does not require the upgrade. WM-DRM features that access the Internet, such as acquiring new licenses

and/or performing a required WM-DRM Upgrade, can be switched off. When these features are switched off, you will still be able to play Secure Content if you have a valid license for such content already stored on your DEVICE.

- **WINDOWS UPDATE AGENT (ALSO KNOWN AS SOFTWARE UPDATE SERVICES)**. If the SOFTWARE includes Windows Update Agent ("WUA") (also known as Software Update Services) functionality that may enable your DEVICE to connect to and access updates ("Windows Updates") from a server installed with the required server component then the following conditions apply:
  - Without limiting any other disclaimer in this EULA, or any EULA accompanying a Windows Update, you acknowledge and agree that no warranty is provided by MS, Microsoft Corporation or their affiliates with respect to any Windows Update that you install or attempt to install on your DEVICE;
  - In addition, you acknowledge and accept that (i) Windows Updates may not be necessary or suitable for installation on or use with your DEVICE or the SOFTWARE, and (ii) if installed or attempted to be installed on your DEVICE, Windows Updates may not function on the DEVICE or may malfunction and/or cause harm to the DEVICE, to operators of the DEVICE or to other persons or property. If you connect to a server that installs a Windows Update, you agree that you assume all risk and liability with regard to any Windows Update that you install or attempt to install on your DEVICE using functionality provided by SOFTWARE. You further agree that neither MS, Microsoft Corporation nor their affiliates have any liability to you with respect to any Windows Update that you install or attempt to install on your DEVICE; and
  - Leica Geosystems is solely responsible for providing technical support, if any, to you in connection with your installation of Windows Updates installed on your DEVICE using WUA functionality provided by the SOFTWARE. Please contact Leica Geosystems if you have any questions regarding any Windows Update that you are considering installing on your DEVICE or otherwise regarding the WUA functionality.

NOTICES REGARDING THE MPEG-4 VISUAL STANDARD. The SOFTWARE may include MPEG-4 visual decoding technology. This technology is a format for data compression of video information. For this technology, MPEG LA, L.L.C. requires this notice:

> "USE OF THIS PRODUCT IN ANY MANNER THAT COMPLIES WITH THE MPEG-4 VISUAL STANDARD IS PROHIBITED, EXCEPT FOR USE DIRECTLY RELATED TO (A) DATA OR INFORMATION (i) GENERATED BY AND OBTAINED WITHOUT CHARGE FROM A CONSUMER NOT THEREBY ENGAGED IN A BUSINESS ENTERPRISE, AND (ii) FOR PERSONAL USE ONLY; AND (B) OTHER USES SPECIFICALLY AND SEPARATELY LICENSED BY MPEG LA, L.L.C.
>
> If you have questions regarding this notice, please contact MPEG LA, L.L.C., 250 Steele Street, Suite 300, Denver, Colorado 80206; Telephone 303 331.1880; FAX 303 331.1879; www.mpegla.com."

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- **BACKUP COPY**. You may make one (1) backup copy of the SOFTWARE. You may use this backup copy solely for your archival purposes and to reinstall the SOFTWARE on the DEVICE. Except as expressly provided in this EULA or by local law, you may not otherwise make copies of the SOFTWARE, including the printed materials accompanying the SOFTWARE. You may not loan, rent, lend or otherwise transfer the backup copy to another user.
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- **INTERNET GAMING/UPDATE FEATURES**. If the SOFTWARE provides, and you choose to utilize, the Internet gaming or update features within the SOFTWARE, it is necessary to use certain computer system, hardware, and software information to implement the features. By using these features, you explicitly authorise MS, Microsoft Corporation, their affiliates and/or their designated agent to use this information solely to improve their products or to provide customized services or technologies to you. MS, Microsoft Corporation or their affiliates may disclose this information to others, but not in a form that personally identifies you.

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- **ADDITIONAL SOFTWARE/SERVICES**. This EULA applies to updates, supplements, add on components, product support services, or Internet-based services components ("Supplemental Components"), of the SOFTWARE that you may obtain from Leica Geosystems, MS, Microsoft Corporation or their affiliates after the date you obtain your initial copy of the SOFTWARE, unless you accept updated terms or another agreement governs. If other terms are not provided along with such Supplemental Components and the Supplemental Components are provided to you by MS, Microsoft Corporation or their affiliates then you will be licensed by such entity under the same terms and conditions of this EULA, except that (i) MS, Microsoft Corporation or their affiliates providing the Supplemental Components will be the licensor with respect to such Supplemental Components in lieu of the "COMPANY" for the purposes of the EULA, and (ii) TO THE MAXIMUM EXTENT PERMITTED BY APPLICABLE LAW, THE SUPPLEMENTAL COMPONENTS AND ANY (IF ANY) SUPPORT SERVICES RELATED TO THE SUPPLEMENTAL COMPONENTS ARE PROVIDED AS IS AND WITH ALL FAULTS. ALL OTHER DISCLAIMERS, LIMITATION OF DAMAGES, AND SPECIAL PROVISIONS PROVIDED HEREIN AND/OR OTHERWISE WITH THE SOFTWARE SHALL APPLY TO SUCH SUPPLEMENTAL COMPONENTS. MS, Microsoft Corporation or their affiliates reserve

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- **RECOVERY MEDIA**. If SOFTWARE is provided by Leica Geosystems on separate media and labeled "Recovery Media" you may use the Recovery Media solely to restore or reinstall the SOFTWARE originally installed on the DEVICE.
- **TERMINATION**. Without prejudice to any other rights, Leica Geosystems or MS may terminate this EULA if you fail to comply with the terms and conditions of this EULA. In such event, you must destroy all copies of the SOFTWARE and all of its component parts.
- **NOTICE REGARDING SECURITY**. To help protect against breaches of security and malicious software, periodically back up your data and system information, use security features such as firewalls, and install and use security updates.

6.7 Hazards of Use

Warning

The absence of instruction, or the inadequate imparting of instruction, can lead to incorrect or prohibited use, and can give rise to accidents with farreaching human, material, financial and environmental consequences.

Precautions:
All users must follow the safety instructions given by the manufacturer and the directions of the person responsible for the system.

Caution

Watch out for erroneous measurement results if the product has been dropped or has been misused, modified, stored for long periods or transported.

Precautions:
Periodically carry out test measurements and perform the field adjustment indicated in the user manual, particularly after the product has been subjected to abnormal use and before and after important measurements.

Caution

Beware of inadequate steering if machine is defective like after a crash of after damaging events or alterations to the machine.

Precautions:
Periodically perform control measurements and field adjustments on the machine as specified in the user manual. While working, paving and grading should be checked by appropriate means, for example spirit level, tachymeter, before and after important measuring tasks.

⚠ Danger

While steering or navigating the machine accidents may occur due a) to the operator not paying attention to the surroundings (e.g. persons, ditches, traffic etc.) or b) malfunctions (e.g. of a system component, interference etc.).

Precautions:
The operator assures, that the machine is operated, guided and monitored by a qualified user (e.g. driver). The user has to be able to take emergency measures (e.g. an emergency stop, ...).

⚠ Danger

Because of the risk of electrocution, it is very dangerous to use poles and extensions in the vicinity of electrical installations such as power cables or electrical railways.

Precautions:
Keep at a safe distance from electrical installations. If it is essential to work in this environment, first contact the safety authorities responsible for the electrical installations and follow their instructions.

⚠ Caution

If the accessories used with the product are not properly secured and the product is subjected to mechanical shock, for example blows or falling, the product may be damaged or people may sustain injury.

Precautions:
When setting-up the product, make sure that the accessories, for example tripod, tribrach, connecting cables, are correctly adapted, fitted, secured, and locked in position. Avoid subjecting the product to mechanical stress.

Warning

By operating this system during a thunderstorm you are at risk from lightning.

Precautions:
Do not carry out field surveys during thunderstorms.

Warning

Inadequate securing of the surveying site can lead to dangerous situations, for example in traffic, on building sites, and at industrial installations.

Precautions:
Always ensure that the survey site is adequately secured. Adhere to the regulations governing safety and accident prevention and road traffic.

Caution

Installing near mechanically moving machine components may damage the product.

Precautions:
Deflect the mechanically moving machine components as far as possible and define a safe installation zone.

Warning

During dynamic applications, there is a danger of accidents occurring if the user does not pay attention to the environmental conditions around, for example obstacles, excavations or traffic.

Precautions:
The person responsible for the product must make all users fully aware of the existing dangers.

Warning

Only Leica Geosystems authorised service workshops are entitled to repair these products.

⚠ Warning

If computers intended for use indoors are used in the field there is a danger of electric shock.

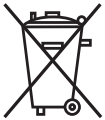
Precautions:
Adhere to the instructions given by the computer manufacturer with regard to field use in conjunction with Leica Geosystems products.

⚠ Warning

If the product is improperly disposed of, the following can happen:

- If polymer parts are burnt, poisonous gases are produced which may impair health.
- If batteries are damaged or are heated strongly, they can explode and cause poisoning, burning, corrosion or environmental contamination.
- By disposing of the product irresponsibly you may enable unauthorised persons to use it in contravention of the regulations, exposing themselves and third parties to the risk of severe injury and rendering the environment liable to contamination.

Precautions:



The product must not be disposed with household waste.
Dispose of the product appropriately in accordance with the national regulations in force in your country.
Always prevent access to the product by unauthorised personnel.

Product specific treatment and waste management information can be downloaded from the Leica Geosystems home page at http://www.leica-geosystems.com/treatment or received from your Leica Geosystems dealer.

6.8 Electromagnetic Compatibility EMC

Description

The term Electromagnetic Compatability is taken to mean the capability of the product to function smoothly in an environment where electromagnetic radiation and electrostatic discharges are present, and without causing electromagnetic disturbances to other equipment.

Warning

Electromagnetic radiation can cause disturbances in other equipment.
Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment may be disturbed.

Caution

There is a risk that disturbances may be caused in other equipment if the product is used in conjunction with accessories from other manufacturers, for example field computers, personal computers, two-way radios, non-standard cables or external batteries.

Precautions:
Use only the equipment and accessories recommended by Leica Geosystems. When combined with the product, they meet the strict requirements stipulated by the guidelines and standards. When using computers and two-way radios, pay attention to the information about electromagnetic compatibility provided by the manufacturer.

Caution

Disturbances caused by electromagnetic radiation can result in erroneous measurements.
Although the product meets the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that the product may be disturbed by very intense electromagnetic radiation, for example, near radio transmitters, two-way radios or diesel generaors.

Precautions:
Check the plausibility of results obtained under these conditions.

⚠ Warning

If the product is operated with connecting cables attached at only one of their two ends, for example external supply cables, interface cables, the permitted level of electromagnetic radiation may be exceeded and the correct functioning of other products may be impaired.

Precautions:
While the product is in use, connecting cables, for example product to external battery, product to computer, must be connected at both ends.

Radios, digital cellular phones

Use of product with radio, digital cellular phone devices or similar:
Electromagnetic radiation can cause disturbances in other equipment, in installations, in medical devices, for example pacemakers or hearing aids and in aircraft. It can also affect humans and animals.

⚠ Warning

Precautions:
Although the product meets in combination with radio or digital cellular phone devices recommended by Leica Geosystems the strict regulations and standards which are in force in this respect, Leica Geosystems cannot completely exclude the possibility that other equipment may be disturbed or that humans or animals may be affected.

- Do not operate the product with radio or digital cellular phone devices in the vicinity of filling stations or chemical installations, or in other areas where an explosion hazard exists.
- Do not operate the product with radio or digital cellular phone devices near to medical equipment.
- Do not operate the product with radio or digital cellular phone devices in aircraft. Do not operate the product with radio or digital cellular phone devices for long periods immediately next to your body.

6.9 FCC Statement, Applicable in U.S.

Warning

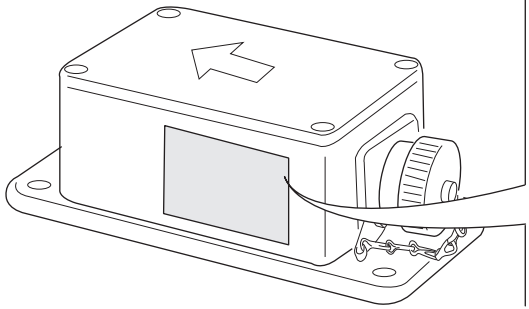
This equipment has been tested and found to comply with the limits for a Class B digital device, pursuant to part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference in a residential installation.
This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instructions, may cause harmful interference to radio communications. However, there is no guarantee that interference will not occur in a particular installation.
If this equipment does cause harmful interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged to try to correct the interference by one or more of the following measures:

- Reorient or relocate the receiving antenna.
- Increase the separation between the equipment and the receiver.
- Connect the equipment into an outlet on a circuit different from that to which the receiver is connected.
- Consult the dealer or an experienced radio/TV technician for help

Warning

Changes or modifications not expressly approved by Leica Geosystems for compliance could void the user's authority to operate the equipment.

Labeling Dual-Axis Slope Sensor



Type: **MSS1200**

Art.No.
726028
S.No.
000100

Power: 11-30V ⎓, 50mA
Leica Geosystems AG
CH-9435 Heerbrugg
Manufactured 2004
Made in Germany
Ident 1: 04-21-20016
Ident 2: 100-XXX-XXX

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interferences received,
including interference that may cause undesired operation.

Labelling, further Information

For details on labelling, please refer to the user manual of the corresponding system component.

7 Technical Data

Leica PaveSmart 3D

Parameter	Data
Elevation accuracy* of machine position	5 - 10 mm (approx. 0.02') / 200m (600 ft)
Position accuracy* of machine	5 - 10 mm (approx. 0.02' - 0.03') / 200 m (600 ft)
Maximum Range (recommended)	± 200 m (600 ft)
Measuring frequency	10 Hz
Supply voltage	12 VDC or 24 VDC
Supply Current (max, at 24V DC)	2 A

* Standard deviation; depends on the condition the machine is in, the paving material, the paving distance, accuracy of reference points (fixpoints), atmospheric influences and the chosen sensor option:
- For TPS1200+ sensors line of sight interruptions, severe heat shimmer and moving objects within the line of sight path can result in deviations of the specified accuracy.
- For GNSS (GPS / GLONASS) sensors the accuracy is dependent upon various factors including the number of satellites tracked, constellation geometry, observation time, ephemeris accuracy, ionospheric disturbance, multipath and resolved ambiguities. A coordinate transformation must be carried out to link the local coordinate system with the WGS 84 GNSS coordinate system prior to any paving works being carried out. The transformation must be verified before paving begins and the control points used, must surround the extents of the area to be paved.
  Refer to the Leica PaveSmart 3D and GPS1200 technical reference manuals for more information, and details on limitations and precautions which should be taken prior to paving.

* For paving work on tight curves the accuracy depends on the physical machine setup, the subground and the paving material.

Slope sensor(s)

Parameter	Data
Humidity	max. 95% RH, non condensing
Vibration	10-500 Hz / 5g / ± 0.35 mm (0.014")
Bump	25 g / 6 ms
Operating temperature	-10 to +70°C / +14 to +158°F
Storage temperature	-25 to +85°C / -13 to +185°F
Operating voltage range	10 ... 30 Volt DC
Current consumption	approx. 50 mA
Principle of measurement	Liquid sensor
Measuring range	-170% ... +170%, typical -60° ... +60°
Internal resolution	0.015% 0.01°
Linearity	±0.2% of range
Temperature coefficient (Zero)	‹0.001% /K ‹5*10 -4 °/K
Temperature coefficient (Amplifier)	‹0.02 %/K ‹1*10 -2 °/K
Reproduceability	0.035% 0.02°
Time constants (T90)	min. 0.3 sec settable
Sensing frequency	max. 100 Hz settable
CAN interface	ISO 11898 - 24 V
CAN communication rate	125 kBits/sec
Polarity protection	exists
Enclosure protection	IP 54 (IEC60529)
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